1997 Beneficial Use Reconnaissance Project Workplan

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Prepared for the Idaho Division of Environmental Quality
by the Beneficial Use Reconnaissance Project Technical
Advisory Committee

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Chapter 1: Introduction to the BURP Process

History of Idaho Water-Quality Programs

The Clean Water Act

In 1972, Congress passed public law 92-500, the Federal Water Pollution Control Act, commonly known as the Clean Water Act (CWA). The objective of this act is to "restore and maintain the chemical, physical, and biological integrity of the Nation's waters." In recognition of the diverse nature of the nation's waters, states are given authority under the CWA to adopt water-quality standards. The Division of Environmental Quality (DEQ) is the state agency responsible for implementing the CWA in Idaho. The Environmental Protection Agency maintains overall guidance and oversight of water-quality efforts and retains the authority to promulgate federal water-quality standards for the states should the state agencies fail to do so. Thus, the EPA oversees Idaho's water-quality standards and certifies that the state is fulfilling the requirements and responsibilities of the CWA.

One of the national goals listed in the 1977 amendment to the CWA is protection and management of waters to insure "swimmable and fishable" conditions. This objective--coupled with the original 1972 objective of restoring and maintaining the chemical, physical, and biological integrity of waters--relates water quality to more than just chemistry. The Clean Water Act recognizes that water quality has three major components: (1) chemical; (2) physical; and (3) biological, which is dependent on the former two. These components are recognized by the EPA, which requires state monitoring programs to include physical, chemical, and biological data (40 CFR Section 130.3(b)). Section 303(c)(2)(B) of the CWA further states: ". . . such States shall adopt criteria based on biological monitoring or assessment methods." Section 304(a)(1) of the CWA states: "States shall develop and publish criteria for water quality accurately reflecting the latest scientific knowledge . . . on the effects of pollutants on biological community diversity, productivity, and stability, including information on the factors affecting rates of eutrophication and rates of organic and inorganic sedimentation for varying types of receiving waters." The Environmental Protection Agency (1990) requires states to adopt narrative biological criteria by 1993 and numeric by 1996.

Idaho Water-Quality Standards

Water-quality standards are legally-established rules consisting of two parts: designated uses and criteria (Karr 1991). Designated uses are those beneficial uses deemed desirable and appropriate for a particular water body through some forum or public process. For Idaho, these are the uses listed in the *Idaho Water Quality Standards and Wastewater Treatment Requirements*. Criteria are the conditions presumed to support or protect the designated uses (Karr 1991). There are two types of criteria: narrative, which define rather than quantify conditions that must be maintained to support a designated use, and numeric, which establish the minimum physical, chemical, and biological parameters required to support a beneficial use (US EPA 1995). This dual nature of water-quality standards demands an assessment of the status of beneficial uses and classic evaluation of numeric criteria.

Programs to control nonpoint-source (NPS) pollution remain largely unsuccessful because of the difficulties involved in applying point-source (PS) approaches to diffuse NPS problems (Karr 1991). Karr also noted that efforts to measure or gauge water-quality improvement have not been successful because of an inability to associate water-quality standards with biological integrity. "Despite expenditures of at least $473 billion to build, operate, and administer water pollution control facilities since 1970, the nation's water resources continue to decline in both quality and quantity" (Water Pollution Control Federation 1991). The complexities of NPS pollution and the realization that water-quality standards do not always relate to biology have led water-quality authorities to embrace the concept of ambient monitoring of biological integrity as a direct, comprehensive indicator of ecological conditions. Many researchers and ecologists are advocating biology as the best indicator of pollution or biological integrity related to human influences (Davis and Simon 1995; Weber 1981).

Creation of the Beneficial Use Reconnaissance Project

In 1993, DEQ embarked on a pilot program aimed at integrating biological and chemical monitoring with physical habitat assessment as a way of characterizing stream integrity and the quality of the water (McIntyre 1993a). This program was also developed as a response to CWA requirements to monitor and assess biology as well as to develop biocriteria. This pilot, named the Beneficial Use

Reconnaissance Project (BURP), relied heavily on protocols for monitoring physical habitat and macroinvertebrates developed by DEQ in the early 1990s. It closely followed the *Rapid Bioassessment Protocols for Use In Streams and Rivers* put together by EPA (Plafkin et al. 1989). This document was an attempt to use the best science and understanding available to characterize water quality based on biological communities and their attributes. Because of the success of the 1993 pilot, DEQ decided to expand the project statewide for 1994 (McIntyre 1994; Steed and Clark 1995). A Technical Advisory Committee was formed to evaluate the 1993 effort and arrive at a definitive workplan for 1994 (McIntyre 1994). The overall program remains unchanged for 1997; however, some modification of procedures and protocol has occurred in an effort to minimize qualitative information and increase accuracy in water-quality assessments.

Legal Challenges to Idaho Water-Quality Programs

At the same time DEQ was developing the BURP pilot, legal challenges to both Idaho's § 303(d) list of water-quality limited water bodies and the state's water-quality standards were making their way through the federal court system (*Idaho Sportsman's Coalition v Browner*, W.D. Wash. No. C96-807-WD and *Idaho Conservation League v Browner*, W.D. Wash. Case No. C93-943-WD). These two cases have dramatically affected how DEQ monitors and reports water quality as well as how standards are developed.

In *ISC v. Browner*, the Idaho Sportsman's Coalition contended that there were many more water bodies that should be on Idaho's 1994 § 303(d) list. The judge ruled in the plaintiff's favor in 1994, finding EPA "arbitrary and capricious" in their review and approval of Idaho's 1992 § 303(d) list. He ordered EPA to develop a new § 303(d) list for Idaho, submit a schedule to address the water bodies on the § 303(d) list, and establish a process for dealing with total maximum daily loads (TMDLs). A TMDL is a written, quantitative assessment of water-quality problems and contributing pollutant sources. It specifies the amount of a pollutant or other stressor that needs to be reduced to meet water-quality standards, allocates pollution-control responsibilities among sources in a watershed, and provides a basis for taking actions needed to restore a water body. The Environmental Protection Agency put together a new §303(d) list for Idaho, listing some 960 plus water bodies as water quality limited. This action was particularly important since the CWA requires the state to develop a TMDL for each water body on the list. If the state fails to do so or is unable to do so, EPA is then required to develop the TMDLs for the state. TMDL development typically takes three to five years to complete at a cost of several million dollars.

In response to this ruling, the 1995 Idaho legislature passed Senate Bill 1284 [see Idaho Code §39:3601 *et seg.*] to address this situation and reaffirm state control. The law designated DEQ as the responsible state agency, created citizen advisory groups to provide input to recovery plans, and established funding for a statewide ambient monitoring effort (BURP) for the 960 listed water bodies. The Environmental Protection Agency submitted a schedule for development of TMDLs, drafted in cooperation with DEQ, to the judge in May of 1996. The schedule granted DEQ twenty-five years to address all required TMDLs. In September of 1996, the judge ruled that the May schedule was inadequate and that it did not specify when particular listed water bodies would have a TMDL completed and submitted to EPA. He ordered EPA to draft another, more specific schedule in six months. He also suggested that five years was a reasonable time frame. The second, more detailed schedule was due April of 1997.

The second suit, *ICL v. Browner*, dealt with Idaho's water-quality standards and the lack of timely approval by EPA. A triennial review of standards with new revisions was submitted to EPA in 1993. According to the CWA, this review should have been completed within 90 days, with either an approval or disapproval at that time. This did not happen. The Idaho Conservation League contended that Idaho did not have approved standards, that many waters did not meet the swimmable and fishable goals, and that a majority of waters were unclassified and hence had minimal protection afforded to them by default. The judge ruled in favor of the plaintiff and ordered EPA to promulgate standards for Idaho in 60 days. To deal with this suit, DEQ proposed standards that addressed some of the issues in December of 1996, but not all issues were resolved by this action. To date, many water bodies remain in contention. EPA and DEQ are attempting to resolve these problems.

The 1997 Beneficial Use Reconnaissance Project

Objectives

The objectives of the 1997 BURP are to:

1. document the existing beneficial uses of water bodies to the extent possible at a reconnaissance level-intensity;

2. determine beneficial-use support statuses, which will include the

characterization of aquatic reference conditions; and

3. determine if a reconnaissance assessment effort for non-wadable water bodies is feasible, applicable, and usable.

Feasibility:	Equipment needs, personnel skills, safety precautions, training requirements, and time required to complete monitoring are reasonable.
Applicability:	Methods can be implemented statewide.
Usability:	Collected data provides meaningful information related to meeting objectives of BURP.

4. monitor all water bodies in the state within a five-year period.

Scope

As indicated by the name of the project, BURP is a reconnaissance-level monitoring effort. There are limits on how much interpretation can be done with the type of data collected through this process. The Beneficial Use Reconnaissance Project is intended to merely differentiate between impaired and non-impaired water bodies. It is not intended to identify pollutants or their sources. It may be possible, however, to suggest causative agents of pollution through a synthesis of all existing data, be it BURP or other supporting evidence. Refinement of causative agents, quantification of their effects, and likely sources of pollution will be dependent on future monitoring above and beyond the scope of this project.

The BURP Workplan

Creation and Description

The Beneficial Use Reconnaissance Project workplan was developed by the Idaho Division of Environmental Quality's Technical Advisory Committee (TAC). The committee primarily comprises technical staff from the DEQ Central Office and each of the six regional offices; other technical experts were involved when needed. The first workplan was written in 1994 and has been revised each year by the TAC to incorporate changes in methods and protocol gained from experience. Additionally, this year's workplan includes methods for monitoring rivers, lakes, and reservoirs. Each annual workplan is used as a guide for training field crews and provides quality assurance for statewide consistency in monitoring.

The workplan describes the methods used by DEQ to measure water quality, beneficial-use status, and general water-body health. The methods described in the workplan are meant to prescribe a reconnaissance level screen of water conditions. The Technical Advisory Committee considered time constraints, staff limitations, and costs in developing the workplan and selecting the methods to be used. The overall process strives to balance the use of the best technology available with the need to assess hundreds of water bodies over a five-year period.

The document is organized as a single workplan for wadable streams, large rivers, lakes, and reservoirs in order to provide consistency and reduce redundancy. Consequently, it combines sections that are applicable to more than one water-body type. For instance, the introduction, purpose, objectives, scope, and existing data review sections are applicable to wadable streams, large rivers, lakes, and reservoirs. The Rationale for Selected Parameters section (Chapter 2) indicates, using icons, which constituent is relevant to which water-body type. The document has three separate sections describing core parameters, method references, and method modifications for wadable streams, large rivers, lakes, and reservoirs. The workplan then follows with Quality Assurance and Quality Control, which are pertinent to all the water bodies. The Quality Assurance and Quality Control section indicates which written portions are appropriate to the water body type.

Purpose

There are several purposes behind this workplan. The most important are to:

1. provide statewide consistency in the monitoring, data collection, and reporting as described in the *Coordinated Nonpoint Source Water Quality Monitoring Program for Idaho* (Clark 1990);

2. develop methods applicable to any water body regardless of size or location in Idaho; and

3. identify the principal measures that provide significant insight into the ecology, biology, and water quality of monitored water bodies and determine their relation to beneficial uses.

New Sections for 1997

The 1997 workplan incorporates two new sections: one for large rivers, and a second for lakes and reservoirs. Approximately 100 rivers and another 40 lakes or reservoirs are on Idaho's 1996 § 303(d) list. Monitoring and assessment methods were developed to address these systems. For large rivers, DEQ will rely heavily on protocol developed by Idaho State University (ISU) and the U.S. Geological Survey (USGS). For lakes and reservoirs, existing protocol from the U.S. Environmental Protection Agency (US EPA), DEQ, and USGS will be used.

Large Rivers

DEQ and others recognize the lack of information on monitoring and assessing large rivers (Meador et al. 1993). There are several reasons for this lack of information: size (spatial considerations), significant human influences, greater resource requirements, and the highly variable biological and physical characteristics of these systems. In order to address this situation, DEQ entered into a contract with ISU to develop and test rapid biomonitoring and assessment methods for large rivers. This project was to take into account different indicators of degradation and correlate them to levels of human influence. Idaho State University has developed a preliminary index, known as the Idaho River Index (IRI), to assess the status of large rivers in Idaho (Royer and Minshall 1997). Their method relies upon experience gained from their wadable stream biomonitoring development and USGS National Water-Quality Assessment Program (NAWQA).

The Idaho State University protocol specifically addresses Idaho rivers and calls for the collection of data representative of each water body. Initially, ISU selected many parameters to identify significant physical and biological measures that would evaluate the water quality conditions of large rivers. Various parameters were discarded if found to be redundant or statistically insensitive to water-quality conditions. DEQ reviewed the final set of ISU measures and further refined them to arrive at manageable and useful measures that can be easily and cost-effectively implemented by the agency.

Lakes and Reservoirs

Idaho has more than 1,300 named lakes and reservoirs (Milligan et al. 1983). Many of these are used primarily for recreation (i.e. they are fishable and swimmable). Others have principal uses that include irrigation water storage, water supply, power generation, and flood control.

Idaho's lakes and reservoirs have been the focus of much monitoring since Kemmerer and others visited the state early this century (Kemmerer et al. 1923). Milligan et al. (1983) have provided a bibliography of studies conducted before the mid-1980s. Since then, federal and state agencies, universities, industries and businesses, and public interest groups have committed funds and effort to investigating the resources of numerous waters. Most of these efforts have focused on traditional measures of trophic state, that is, the chemical and physical properties of water (Milligan et al. 1983; Falter and Hallock 1987; Kann and Falter 1987; Bellatty 1989a, 1989b, 1990, 1991; Breithaupt 1990; Entranco Engineers, Inc. 1990, 1992; Rothrock 1995; Idaho Department of Health and Welfare 1996b; Montgomery Watson 1996). More recently, researchers have begun to incorporate biological monitoring of periphyton, macrophytes, macroinvertebrates, and fish (Hoelscher et al. 1993; Mossier 1993; Cobb et al. 1995; Lockhart 1995; Idaho Department of Health and Welfare 1997b). Inclusion of biomonitoring better fits with the concept of ecological integrity and current DEQ direction.

DEQ has developed a reconnaissance-level protocol for lakes and reservoirs fashioned after Milligan et al. (1983), Mossier (1993), and US EPA(1997). By following the lake- and reservoir-monitoring methods, DEQ hopes to gain a reliable illustration of ecosystem function; the methods are efficient (call for a rapid and cost-effective collection of data), allow for replication, focus on measures that relate to beneficial uses, and incorporate measures that respond to levels of human influence.

Data Analysis and Interpretation

This document only describes how to conduct the BURP process. It lays out the assumptions, methods, data handling, and equipment required. This document does not describe the analysis and interpretation of the data collected.

Interpretation of BURP data and any other relevant water-quality information is described in DEQ's Water Body Assessment Guidance (WBAG) document. The WBAG document outlines the process DEQ uses in determining: 1) existing beneficial uses, and 2) beneficial-use support status (full support, not full support).

The 1997 WBAG will be reviewed for its technical merit and updated by a technical review committee, consisting of scientists representing government, industry, and environmental interests. DEQ intends to disseminate this document to a wider audience once this committee has completed its review.

The Water Body Assessment Guidance will be revised to include large river assessment guidance (DEQ 1996b). The assessment tools for large rivers include the Idaho River Index and Reconnaissance Index of Biotic Integrity. In many cases, aquatic life will be used as a surrogate measure to signal potential exceedances of the standards (narrative and numeric). Such a "flag" will require additional monitoring before an actual exceedance is determined.

Chapter 2: Rationale for Selected Parameters

Monitoring parameters and methods were selected by the TAC and based on BURP objectives and relevant studies. Since the BURP objectives relate to beneficial uses, such as salmonid spawning, cold water biota, and primary and secondary contact recreation, many parameters relate directly to those uses. Where beneficial-use support statuses cannot be evaluated directly, a surrogate measure was selected. A minimum number of parameters are needed to adequately characterize reference stream conditions to determine the level of beneficial-use support, i.e., full support or not full support. Minshall (1993) also suggested using multiple measures because "it is unlikely that any one measure will have sufficient sensitivity to be useful in all circumstances."

Explanation of Icons

The following icons indicate that a parameter is applicable to a given type of water body:

S = wadable streams

R = large rivers

L = lakes and reservoirs

Physical/Chemical Parameters

L

Bathymetry or Depth

Water-basin morphology--or the area, depth, and shape of the water basin--influences water-body hydrodynamics and responses to pollution (Mortimer 1974). Depth is an important physical variable in classifying lakes and reservoirs. Deep lakes are generally more oligotrophic while shallow lakes tend to be eutrophic (Milligan et al. 1983; Bellatty 1989a, 1991; Mossier 1993; Lockhart 1995). While depth likely plays some role in holding down summer temperatures, its greatest effect seems to be in dilution capacity. Woods (1991) found nutrient concentrations increased with depth in Pend Oreille Lake, Idaho's deepest lake, which thereby acts as a nutrient sink. Mean depth has also been related to hypolimnetic oxygen deficits (Cornett and Rigler 1979, 1980). It has been used with macrobenthic biomass to predict fish yield (Hanson and Leggett 1982). Mean depth and dissolved solids (morphoedaphic index) accurately predicted phytoplankton standing crop (Oglesby 1977a) and fish yield (Ryder et al. 1974; Oglesby 1997b).

Canopy Closure (Shade)

Canopy closure is a surrogate for water temperature since vegetation controls the amount of sunlight reaching the stream (Platts et al. 1987). Canopy closure was found to be an important variable in studies by Mulvey et al. (1992) and Overton et al. (1993). Temperature and canopy closure helped explain differences in fish occurrence and abundance in these studies, as well as in the Robinson and Minshall (1992, 1994) ecoregion studies.

Channel Alterations

The natural channel morphology and any channel modifications greatly affect in-stream conditions. Natural channel morphology varies according to area geomorphology, with high-gradient streams often flowing "straight" and low-gradient streams often meandering through floodplains. Channel alterations may include artificial bank stabilization or structures such as artificial embankments and riprap. Other frequently-used modifications include channelization, dams, and bridges (US EPA 1996 a). Such water-management features often destabilize stream banks and increase flow velocities, leading to a greater potential for erosion and sedimentation. The reduction of meanders also changes habitat structural diversity (i.e., pools and riffles). Consequently, fish spawning and macroinvertebrate production are greatly influenced by such activities (Gordon et al. 1992). Land use is closely associated with channel alterations since large rivers often are modified for purposes of flood control, agricultural water supply, and electrical power supply (Rankin 1995).

Conductivity

Conductivity, or specific conductance, refers to the ability of water to conduct an electrical current. It is an indication of the concentration of dissolved solids. Kunkle et al. (1987) found conductivity to be an useful indicator of mining and agricultural effects. Royer and Minshall (1996) found sites designated as degraded generally had higher conductivities. Maret et al. (1997) reported conductivity is one environmental factor determining the distribution of fishes.

S R

Discharge

Minshall (1993) noted that discharge is one of the principal abiotic factors shaping stream ecosystems. Nelson et al. (1992) found discharge regimes to be one of the attributes helpful in distinguishing different geologic regions. Discharge is one of a series of measurements taken by both Oregon and Washington in very similar bioassessment projects (Mulvey et al. 1992; Plotnikoff 1992). Discharge patterns affect habitat characteristics such as erosion, distribution of aquatic assemblages, and movement of suspended materials (Rankin 1995). Discharge and other associated parameters, such as gradient, may provide useful forms of discrimination between water bodies (Rankin 1995). Idaho State University used base flow to differentiate among intermediate- and large-size rivers (Royer and Minshall 1997). Discharge information, particularly annual discharge data, may provide an understanding of natural flow patterns and possible impacts to biological communities.

R L

Dissolved Oxygen

Dissolved oxygen is necessary for aquatic life and is an important indicator of water-body health. It is a priority parameter in lake monitoring (U.S. Environmental Protection Agency 1988). Much information can be obtained from this single measure. Concentrations of dissolved oxygen in the water column determines which aquatic organisms will be able to exist there. It is related to the photosynthetic activities of algae and macrophytes as well as to the decomposition of organic material. Dissolved oxygen gradients can supply insight into the mixing patterns of a water body and the extent of dissolved-oxygen deficits. Anoxic conditions can influence other chemical properties of water through the oxygen-reduction potential (Wetzel 1983).

R

Floodplain Disturbance

As wadable streams become large rivers, the relationship between the water course and its riparian area changes as well. For large rivers, the effect of shading by riparian vegetation is no longer of great importance. The size of the riparian area, however, becomes ecologically significant. The riparian, or floodplain, area serves as a natural filter, water storage facility, and biological breeding area. During the flood stage, when the river leaves its banks and flows out across the floodplain, sediment loads drop and water infiltrates the soils to be released to the river more slowly. At this point, many back-water ponds and wetlands are formed or filled, providing important breeding and rearing grounds. In order to measure this important aspect of large rivers, ecologists have identified floodplain width as an indicator of floodplain function and health (Forman and Godron 1986).

Floodplain width has limited usefulness as an ecological indicator since river floodplain widths vary naturally due to geomorphological differences. Also, measuring floodplain width at a single spot does not provide information about the whole river. Thus, floodplain disturbance is used to assess a much larger area of the river.

Habitat Distribution and Assessment

An evaluation of habitat diversity is critical to any assessment of ecological integrity. Water velocity, in conjunction with depth, has been demonstrated to have a direct influence on the structure of benthic and fish communities (Osborne and Hendricks 1983, as cited in Plafkin et al. 1989; Oswood and Barber 1982). Chapman (1966) stated the physical habitat regulates fish abundance. Researchers have correlated various components of the physical habitat with fish abundance and denoted habitat type as an important factor (Hunt 1969, Graham et al. 1980, Fraley et al. 1981, Shepard et al. 1982, Shepard 1983, Pratt 1984, Irving 1987, Hoelscher and Bjornn 1989, Moore and Gregory 1989). Gorman and Karr (1978) took this relation one step further and found fish diversity, as well as abundance, increased with habitat diversity.

Hydrogen-Ion Concentration (pH)

Hydrogen ion concentration, or pH, as with temperature, is an important regulator of many biological and chemical processes. The composition of aquatic communities is strongly influenced by pH (Marcus et al. 1986). The uptake and release rates of ions across gills, the primary method of ion regulation for aquatic animals, is at least partly pH-dependent (Smith 1982). Similarly, the toxicity of some chemicals is pH-dependent (Wetzel 1983).

Large Organic Debris

Large organic debris (LOD), sometimes referred to as "large woody debris", has been found to be important in smaller streams where the riparian zone consists of evergreens, i.e., forested areas (Everest et al. 1987). Large organic debris has been found to be important for the complexity it adds to stream habitats, its retention of allochtonous matter and sediment, and the stability it imparts to streams under high-flow conditions. Some species of salmonids show a high affinity for LOD (Rieman and McIntyre 1993).

Nutrients

Phosphorus and nitrogen are essential elements for plant growth. Excessive nutrients, however, can lead to eutrophication. This condition is termed "cultural" eutrophication when it is human-caused and has been found to be of concern to national waters (U.S. Environmental Protection Agency 1977). Heiskary and Walker (1988) reported excess nutrient concentrations resulted in aesthetic and "swimmability" problems. Nutrients have been used as an important chemical variable in determining trophic state (Vollenwieder 1976; Dillion and Rigler 1974; Carlson 1977; Milligan et al. 1983; Ryding and Rast 1989). Phosphorus has been found to be correlated to the concentration of chlorophyll *a* (Dillion and Rigler 1974; Carlson 1977; Oglesby 1977a; Lee and Jones 1984) and fish yield (Lee and Jones 1984; Hanson and Leggett 1982; Hoyer and Canfield 1991). Particulate inorganic phosphorus is adsorbed to soil particles and enters waters by sediment transport from the watershed, and is therefore an indication of land disturbance. Particulate organic and dissolved phosphorus can enter water bodies directly.

Photo Documentation and Diagrammatic Mapping

Photographic records provide visual details concerning riparian conditions and river geomorphology. Diagrammatic mapping results in a representative map of the sampling site. The map provides visual information and an approximate scale of important stream characteristics such as land use, geomorphic channel units, habitat features, and bank conditions (Meador et al. 1993). Such visual details complement field notes and habitat measurements. This type of documentation may also provide baseline information concerning qualitative changes in riparian conditions, land use, and river-channel modifications.

Pool Quality

Pool complexity is a measure of pool quality, and pool-to-riffle ratio is a measure of pool quantity. In a study of streams that differed by the amount of management in their watersheds, Overton et al. (1993) found pools in the less impacted watersheds were more frequent, had higher volumes, and were of greater depth than those in the more impacted watersheds. Beschta and Platts (1986) suggested that pool quality is equally as important as the number of pools in describing a healthy stream from a fisheries standpoint.

Riparian Vegetation

The presence and condition of the riparian vegetation is important to the overall ecological health of the river and its floodplain. Healthy stands of riparian vegetation provide habitat for aquatic and terrestrial animals as well as perform important physical functions (e.g. erosion control, sediment catchment). Stands of naturally-occurring riparian vegetation can vary from river to river, depending on climate and geomorphology. Idaho rivers with broad floodplains will typically have large, continuous stands of cottonwoods. Others may have shrubs (willows, river birch) or more grass-like meadows.

Stream-Channel Classification

Streams in Idaho exhibit considerable variability in climate, hydrology, geology, land forms, and soil. Recognizing this, the TAC elected to use Rosgen's (1994) stream classification system as a means of organizing and stratifying streams for comparison. As Conquest et al. (1993) noted, "One way to organize an inherently variable landscape is to employ a system of classification. The general intent of the classification is to arrange units into meaningful groups in order to simplify sampling procedures and management strategies."

Streambank Condition and Material Types

Parameters such as streambank condition and material types correlate to erosion potential. Removal of streambank vegetation and soil reduces the structural stability of the stream channel and negatively affects fish productivity (Platts 1990; Platts and Nelson 1989). Banks stabilized by deeply-rooted vegetation, rocks, logs, or other resistant materials are less susceptible to flow-related erosion, reduce water velocity along the stream perimeter, and aid in beneficial sedimentation (Bauer and Burton 1993).

Substrate and Embeddedness

Sediment and its accumulation is detrimental to salmonid spawning (a beneficial use) since it limits the quality and quantity of the inter-gravel spaces, which are critical for egg incubation (Maret et al. 1993; Young et al. 1991; Scrivener and Brownlee 1989). Fine sediment and availability of living space have direct effects on both fish and insects (Marcus et al. 1990; Minshall 1984). Embeddedness has been associated with reduced spawning areas, habitat space, and macroinvertebrate reproduction. Several studies and state projects have found relative substrate size to be an important indicator of water-quality effects due to activities in the watershed (Overton et al. 1993; McIntyre 1993b; Skille 1991).

S R L

Temperature

Water temperature is an easily-measured physical parameter which has considerable biological and chemical significance. Fish and essentially all other aquatic plant and animal processes are temperature-dependent. Increased water temperatures are known to increase biological activity, and temperature can reach lethal limits for fishes (Smith 1982). The potential, or maximum, concentration of dissolved oxygen is inversely proportional to water temperature (Wetzel 1983).

Temperature profiles are one of the highest-priority parameters in lake monitoring (U.S. Environmental Protection Agency 1988). Such profiles often concentrate on thermal stratification, a common characteristic of lakes. In their simplest form, lake strata include a layer of warm, relatively light surface water (epilimnion) and a cold, dense layer on the bottom (hypolimnion) separated by a transition layer (metalimnion or thermocline) with a strong temperature gradient. The gradient prevents the epilimnion from circulating any deeper, thus isolating the hypolimnion waters from the water-body's surface. The significance of stratification is that no exchange of dissolved constituents, such as gases or nutrients, is possible between the epilimnion and the hypolimnion. During summer stratification, organic material produced in the epilimnion settles into the hypolimnion and bottom sediments where it is decomposed. Dissolved oxygen is used in the decomposition and cannot be replenished, thus decreasing the amount of oxygen available to life in the water column.

R L

Water Clarity

Secchi-disk measurement is a simple, effective, and widely-used method of determining water clarity. Clarity of water has been an important physical variable in determining trophic state (Carlson 1977, Milligan et al. 1983, Ryding and Rast 1989); the US EPA (1988) ranked it as one of the highest-priority parameters in lake monitoring. Secchi-depth transparency is influenced by the absorption characteristics of water. It has been correlated to chlorophyll *a* concentrations (Carlson 1977; Mills and Schiavore, Jr. 1982) and is influenced by other factors such as turbidity and dissolved organic color. Chambers and Kalff (1985) reported the depth of light transmittance relates to maximum macrophyte depth. Mossier (1993) concurred that the two were highly, positively correlated. Because of its relationship to water-clarity--a parameter readily observed by users of water bodies--Secchi-disk measurement is a good surrogate for the public's perception of water quality.

Width and Depth

S R

Width and depth measurements, along with discharge data, provide meaningful information about river size and habitat characteristics. These variables have significant impact on the distribution of the aquatic community. Grouping rivers by width and depth, furthermore, may be useful for purposes of data comparison (DEQ 1996 a).

Biological Parameters

Aquatic Macrophytes

R L

Aquatic macrophytes affect water quality through species presence and abundance. Mossier (1993) found the diversity of prevalent species generally demonstrated a twofold increase from eutrophic to mesotrophic to oligotrophic lakes. The presence of Eurasian water milfoil, an invasive aquatic macrophyte, has been shown to affect beneficial uses (Coots and Carey 1991). According to the river continuum concept, macrophytes become more abundant in intermediate to large rivers (Vannote et al.1980). This theory is typically supported in lowland rivers where lower gradient and finer sediment produce suitable conditions to cultivate macrophyte establishment and growth. Some natural systems have unacceptable conditions for macrophyte establishment due to depth (decreased light penetration), turbidity, swift current, unstable substrate, and lake and reservoir water level fluctuations. Depending on the ecology of the system, macrophytes may typically provide food (in the form of detritus) and shelter. In ecologically unstable conditions, however, macrophytes may produce dense mats which are aesthetically objectionable (Coots and Carey 1991; Allen 1995) and reduce fish yield (Coots and Carey 1991). Consequently, macrophytes are an important component of the biological community. Some macrophyte indices have been developed and used in other bioassessments (Lockhart 1995, Small et al. 1996).

Fecal Coliform

R L

Although fecal coliform is not a pathogen, its quantification has been used as a surrogate for measuring pathogens in the water column. Through numerical fecal-coliform criteria, the state of Idaho has set water-quality standards to protect primary- and secondary-contact recreation beneficial uses (IDAPA 16.01.2100, .03, .06, .07).

S R L

Fish

Fish contribute significantly to the ecology of the aquatic community. This biological assemblage is highly visible to the public and is an important economic resource in Idaho. Additionally, fish have relatively long life spans which can reflect long-term and current water-quality conditions. Due to their mobility, fish also have extensive ranges and may be useful for evaluating regional and large-habitat differences (Simon and Lyons 1995).

S R L

Macroinvertebrates

Macroinvertebrates are an essential part of the BURP process. This biological assemblage reflects a stream's overall ecological integrity. Because most streams are monitored infrequently, chemical monitoring is rarely representative of the long-term condition of the stream. Biological monitoring provides an wholistic representation of water conditions; it provides better classification of the stream's support status because the biological community is exposed to the stream's conditions over a long period of time. Macroinvertebrates are useful assessment tools because they are ubiquitous, include numerous species, and respond to physical and chemical impacts in the water column (Rosenberg and Resh 1993). Additionally, macroinvertebrates with certain environmental tolerances may provide some insight to pollutants (Johnson et al. 1993).

R L

Periphyton

Periphyton (algae) is a useful indicator because of its wide distribution, numerous species, and rapid response to disturbance (US EPA 1996b). Since periphyton exists in the water column, it is affected by both physical and chemical factors. Diatoms, a type of periphyton, have frequently been identified as useful biological indicators, particularly in Montana, Kentucky, Oklahoma, and European countries (Round 1991; Rosen 1995). Periphyton supplements fish and macroinvertebrate information due to its different trophic levels, motility, and life history (Allen 1995). Periphyton information, along with information on macroinvertebrates, may also serve as a back-up source of biological data if current fish information is unavailable for a particular river.

L

Phytoplankton/Chlorophyll *a*

Phytoplankton is largely responsible for primary production in aquatic environments (Wetzel 1983). Virtually all dynamic features of water such as clarity (Carlson 1977; Mills and Schiavore, Jr. 1982), trophic state (Dillion and Rigler 1974; Carlson 1977; Milligan et al. 1983; Ryding and Rast 1989), zooplankton (Mills and Schiavore, Jr. 1982; Canfield and Watkins 1984), and fish production (Ryder et al. 1974; Oglesby 1977b; Jones and Hoyer 1982) depend to a large degree on the phytoplankton. Power et al. (1988) found beneficial uses can be affected by excess phytoplankton in lakes and slow-moving water bodies.

The quantity of phytoplankton indicates the degree of eutrophication. Chlorophyll *a* concentration is an often used surrogate measure for phytoplankton abundance (Carlson 1977; Milligan et al. 1983; Ryding and Rast 1989). Chlorophyll *a* concentration can help determine the degree of degradation and can be used to determine if high levels of critical nutrients are present (Dillion and Rigler 1974).

The quality, or speciation, of phytoplankton is equally as important. Many forms have different physiological requirements and vary in response to physical and chemical parameters such as light, temperature, and nutrients. Mossier (1993) found blue-green algae were a significant and dominant part of the phytoplankton community for many eutrophic and mesotrophic lakes, while oligotrophic lakes showed no blue-green algae. Falter et al. (1992) noted the ascendancy of green and blue-green algae in Pend Oreille Lake was an indicator of increased pelagic productivity.

Chapter 3: Wadable-Stream Methods

Pre-Monitoring Steps

Stream Selection

Idaho has many diverse environments within its borders. Thus, criteria for selecting streams to monitor must be flexible enough to address the range of conditions encountered. To assist in prioritizing monitoring efforts, the TAC identified the following five categories of streams to be considered when the Regional Offices select streams for monitoring:

1. water quality limited streams [per 1996 § 303(d) list];
2. streams with reference conditions (Plafkin et al. 1989; Harrelson et al. 1994);
3. streams with little or no monitoring information;
4. Cumulative Watershed Effects Process (IDL 1995) streams identified by the Idaho Department of Lands; and
5. streams recommended by the Basin Advisory Groups.

The convention for naming streams follows the *Geographic Names Information System (GNIS) Idaho* (U.S. Geological Survey 1995).

Existing Data Review

Review of outside data is important when analyzing different water bodies and choosing stream sites for monitoring. This cost-effective step should be performed for each sampling reach. Before a stream is monitored, the regional office contact should check for available data at sources such as:

- Idaho Department of Fish and Game
- Idaho Division of Health (Health Districts)
- Idaho Department of Water Resources
- Idaho Division of Environmental Quality (internal sources)
- Bureau of Land Management
- Bureau of Reclamation
- Natural Resource Conservation Service
- Tribal Nations
- Universities
- U.S. Fish and Wildlife Service
- U.S. Forest Service
- U.S. Geological Survey
- EDMS (IDWR)
- STORET (US EPA)
- Internet searches (if access available)
- GIS coverages from DEQ and other agencies
- Hydropower companies

Site Selection

The placement and number of BURP sites on a stream are difficult issues to address in a consistent statewide method. The minimum site length should be 20 times the wetted width, or 100 meters, whichever is larger. In addition to the length requirement, there another major factor that BURP coordinators have identified as important when selecting sites for monitoring: representativeness. In order to apply conclusions from data analysis to longer stream reaches or entire streams, the sample sites must be representative. Representative sampling can be accomplished through:

1. pre-monitoring planning (see Existing Data Review above), which may involve consulting with representatives from other resource agencies, searching and examining existing stream data, or investigating aerial photos;

2. selecting several sites that cover the potential range of variability determined above; and

3. selecting a few sites in the field that are determined to be the most representative of the stream reach or entire stream.

Determining the ecoregion (Omernik and Gallant 1986) in which the site is found is helpful when choosing representative sites. Ecoregion boundaries are represented by lines on a map; these boundaries do not always correspond to a sharp change, but rather a gradational change in ecology or ecotone. Robinson and Minshall (1992, 1994) reported that ecoregional classification represented real differences in biotic communities; ecoregional classification, therefore, refers to actual stream and site characteristics which should be taken into account. When a sample site is near an ecoregion boundary, it is suggested that crews evaluate which ecoregion type is most representative of that site as determined by the on-site flora and fauna.

Representativeness also includes a consideration of stream order. The *Division of Environmental Quality Guidelines for Determining Beneficial Use Attainability and Support Status* (1994) states that BURP sites should not represent multiple stream orders. In other words, if a stream has three orders, at least one site per order must be established to determine beneficial-use attainability and support status for the entire stream. Regional BURP Coordinators should consider both stream order and stream channel classification (Rosgen), a related parameter, in choosing sites for BURP crews to monitor.

Private Property
Researching the ownership of the land on which a BURP site is located should always be part of the BURP pre-monitoring planning process. Private property is respected by DEQ. Crews should never purposely enter private property without permission from the owner. Unfortunately, obtaining such permission is often laborious and not always successful. These difficulties make sites on public property--state and federal land--much more appealing than those on private property.

Criteria for use of Wadable Stream Methods

Before crews may use the wadable stream methods described in this chapter for the chosen sample site, one of the following criteria must be met:

- The entire sampling site is safely wadable.
- The entire set of methods for wadable streams can be performed.

Core Parameters

Core parameters will be measured consistently by all BURP crews in order to obtain reliable and comparable data. Parameters were selected based on the goal of assessing the beneficial-use support statuses of waters rapidly and cost-effectively. In this chapter and the following two chapters, the core parameters, method references, measurement specifications, and method modifications will be listed for each type of water body. Some measures directly evaluate beneficial uses while others are surrogate measures for uses that cannot be directly assessed at a reconnaissance level.

Note: A "(Q)" after the parameter indicates that it involves a quantitative measurement, while an "(S)" signifies that it involves a subjective (or qualitative) measurement.

Photo Documentation (Q)

Method Reference: Cowley 1992

Measurement Specifications: Take photographs pointing upstream and downstream at the lower end of the site.

Method Modifications: Each crew is supplied with slide film, date-back cameras, and compasses. Record the azimuth in which each photo was taken.

Stream Channel Classification (S)

Method Reference: Rosgen 1994

Measurement Specifications: Classify to the letter level (A,B,C...) only.

Method Modifications: In order to determine Rosgen letter classification of the stream channel, the following information must be collected: elevation, slope, stream order, and valley type. Additional descriptive items, such as aspect and lithology, may be collected in the field or in the office.

Temperature (Q)

Method Reference: Franson 1995

Measurement Specifications: Take one instantaneous stream temperature measurement. Ambient air temperature measure is optional.

Discharge (Q)

Method Reference: Harrelson et al. 1994

Measurement Specifications: One measurement per site, set-interval method.

Method Modifications: Locate a straight, non-braided stretch of the sampling site. Place a measuring tape across the stream perpendicular to the flow. Take evenly-spaced velocity measurements from wetted bank to wetted bank so that no more than five percent of the total discharge is in each partial cross-section, or cell (Harrelson et al., 1994). Record the horizontal distance from the tape and record the depth and velocity from the top-setting wading rod and electromagnetic velocity meter. On very narrow streams with homogenous depth and substrate, having more then 10% of the total discharge in a cell is acceptable for reconnaissance-level monitoring purposes. Also note that for depths greater than 2.5 feet, two velocity measurements are taken for each partial cross-section: one at 20% of total depth, and a second at 80% of total depth.

Macroinvertebrates (Q)

Method Reference: Clark and Maret 1993

Measurement Specifications: Use a Hess sampler with 500-μ mesh at three riffle habitat units; use a Surber sampler if conditions do not permit the use of a Hess.

Method Modifications: Locate the first riffle upstream from the beginning of the site (downstream end) and select a random location within that riffle. Stretch a tape along one bank from the lower to the upper end of the riffle. Choose a random number on the tape. Stretch the tape across the riffle at this random location. Choose a random number and locate it on the tape stretched across the riffle; place the sampler at this location.

Using a Hess sampler, stir substrate and brush rocks for a minimum of two minutes (strive for a consistent time of three to five minutes per sample). Place the sample into a container, label inside and out, and preserve with 70% ethanol (container should be ½ to ¾ full). If the sample is high in organic matter or water, it may need to be preserved with a higher strength of alcohol. If the container is more than half-full of sample material, the contents should be divided into two containers of fresh alcohol or rinsed with 70% ethanol three times within 24 hours. In cases where a single sample is divided into more than one container, the sample labels and field data forms must clearly reflect the sample identity. Preserve the three samples separately in the field; they will be composited later by the lab.

Care should be taken not to damage the invertebrates during all phases of sample collection. All sample processing of macroinvertebrates in the field should be done over a white pan, including the process of transferring the sample from the net to the sample container. Any sample that is found in the white pan following sample processing can be washed into the sample bottle with ethyl alcohol.

After sampling is completed at a given site, all brushes, nets, and other items that have come in contact with the sample must be rinsed thoroughly, examined carefully, and cleaned of any algae or other debris. All equipment should be examined again prior to use at the next sampling site and cleaned if necessary.

The sample labels must be on archival-grade, heavy paper that is able to withstand storage in alcohol (we recommend Resistall Paper 36#). Alcohol-proof ink must be used for the field information written on the label. Labels should be placed inside the jar as well as taped to the outside of the jar.

Fish (S)

Method Reference:	Chandler et al. 1993
Measurement Specifications:	Collect fish in the BURP site or an equivalent length of stream which includes all habitat types encountered in the BURP site. The minimum effort is one pass without block nets. Voucher up to 6 individuals for each species; measure the total length of all salmonids.

Method Modifications: (Core Methods) Before collection, obtain a fish collection permit or coordinate the electrofishing effort with permitted personnel. If a BURP site is being used, electrofish the site after macroinvertebrates have been collected and before habitat measurements are take. During electrofishing, proceed up the thalweg of the channel for streams less than five meters in wetted width and in a zig-zag pattern for larger streams. Sample all habitat types.

Prepare equipment to measure length (weight scales optional), and prepare recovery chamber prior to applying anesthesia. Collect all fishes seen. Apply anesthesia as recommended in Chandler et al. (1993).

Measure the total length of each fish of the family Salmonidae. Salmonids occurring in Idaho include rainbow trout/steelhead trout, cutthroat trout, rainbow/cutthroat trout hybrids, brook trout, bull trout, brook/bull trout hybrids, brown trout, brook/brown trout hybrids (tiger trout), lake trout, brook/lake trout hybrids (splake), golden trout, kokanee/sockeye salmon, coho salmon, chinook salmon, lake whitefish, mountain whitefish, Bear Lake whitefish, pygmy whitefish, Bonneville whitefish, Bonneville cisco, Atlantic salmon, and arctic grayling. If hundreds of young-of-the-year are collected, a random subsample of the total catch of each salmonid species may be measured for total length.

All young-of-the-year should be counted. Count each fish of non-Salmonidae families collected. Voucher up to six (6) specimens of each species as the fish collection permit allows. Voucher according to Appendix XI. Make a one inch incision along the right side of fish greater than 250 mm.

Record the amount of electrofishing effort (time) spent on the site. Record the effort (time) for each pass if multiple passes are made. Record the proportion of habitat types within the site on the fish data sheet if different than the BURP site. Record stream length and average width (minimum of three transect measurements) of the site electrofished, if different than the BURP site.

(Optional Methods) Use closed-population or mark-recapture assessment methods using block nets and multiple passes. Weigh each specimen of the family Salmonidae; if hundreds of young-of-the-year are collected, weigh the total catch of each salmonid species collectively. All young-of-the-year should be counted. Record length and weight of all non-Salmonidae fishes.

Substrate (Q)

Method Reference: Wolman 1954

Measurement Specifications: Collect at least 50 substrate particles at each of three riffle habitat units; set interval method.

Method Modifications: BURP uses the modified Wolman pebble-count method to determine the amount of surface fines (defined as material <6.35 mm by Chapman and McLeod 1987), an index of sedimentation and beneficial-use impairment.

Conduct pebble counts at the same three riffle habitat units where macro-invertebrates were sampled. Begin at the bankfull level on one stream bank and proceed across the riffle to the bankfull level on the opposite stream bank. Select pebbles at equidistant intervals (heel to toe, one pace, each foot on a tape, etc.). At each interval, reach to the stream bottom, pick up the first particle touched, and measure the intermediate axis. Record on the BURP field form the size class of the particle and whether the particle was chosen from within the wetted stream channel. Place the particle downstream of the transect line. Conduct the pebble count with as little bottom disturbance as possible. A minimum of 150 particles measured from three riffles (50 per riffle) is required. Record measurements until the bankfull stream bank is reached, even if the 50 counts are reached before a transect is completed. If multiple passes are required to reach the minimum 50 pebbles per riffle, each successive pass must be upstream from the previous pass.

Canopy Closure (Shade) (Q)

Method Reference: Bauer and Burton 1993, p. 68

Measurement Specifications: Measure at three riffle habitat units; use habitat distribution measurements to weight calculations.

Method Modifications: Use a concave, spherical densiometer. The number of densiometer grid intersections obstructed by overhead vegetation is recorded; the maximum number of obstructed intersections is 17. Densiometer measurements should be taken on the riffle relative to where the macroinvertebrate samples were taken. For stream orders 1-4, the following four readings are taken per cross section: right bank, left bank, from the center of the stream facing upstream, and from the center of the stream facing downstream.

Width and Depth (Q)

Method Reference: Bauer and Burton 1993, p. 86

Measurement Specifications: Measure wetted and bankfull conditions at three locations.

Method Modifications: Although the three-measurement method for width-depth measurement of streams less than 100 feet in wetted width have reportedly been accurate (Platts et al. 1983), the following BURP method was developed as a means to provide slightly greater resolution without the encumbrance of channel profiling:

At each site, a transect is established 10 meters upstream of each macroinvertebrate collection location. If the distance between transect #3 and the end of the marked site is less than ten meters, continue past the end of the site to mark a spot ten meters upstream of the transect. The procedure is conducted from the left bank to the right bank while facing upstream. Stretch, secure, and level the tape across the bankfull (BF) width of the stream. Measure and record the BF width. Measure and record the vertical distance from the tape at the BF elevation to the left wetted edge (LWE). Measure and record the wetted width (WW). Measure and record the bankfull depth (BD) from the tape to the channel bottom at evenly spaced increments across the wetted width according to the following guideline (intervals calculated by WW divided by n+1):

WW	# measurements(n)
≤ 1 meter	3
> 1 but ≤ 4 meters	5
> 4 meters	7

Calculate and record the average wetted depth (AWD).

When a width/depth transect is measured in a split channel, there are two ways to make the measurement. Bankfull measurements should be taken in the channel with the most discharge if the area between the channels is above the ordinary high-water level. Bankfull measurements should be taken across both of the channels if the area between the channels is below the ordinary high-water level.

If the transect has an undercut bank, measure and record the horizontal distance of the undercut. If the transect contains a vertical bank, record tape-to-water-surface as well as tape-to-stream-bottom, but place only the latter measurement in the shaded, depth-measurement boxes. Modify your original 1997 BURP field form so that there is a entry line for the undercut horizontal measurement and an entry line for the tape-to-water-surface measurement for vertical banks.

Also indicate on the field form the type of habitat (riffle, run, pool, glide) in which the width/depth measurements were taken; do this for each transect.

Habitat Distribution (S)

Method Reference: Schuett-Hames et al. 1992; Dolloff et al. 1993

Measurement Specifications: Determine the type of habitat units present along the longitudinal stream axis.

Method Modifications: Visual determination of habitat units can be subjective and imprecise because they are not always clearly defined (Platts 1982). The Western Division of the American Fisheries Society formed a committee to standardize definitions related to habitat evaluations (Helm et al. 1985). Other researchers have combined habitat types into macrohabitat units, which have equivalent structure, function, and responses to disturbance. This improves observer recognition and the ability to replicate surveys in the future (Schuett-Hames et al. 1992).

Oswood and Barber (1982) proposed four general categories, or macrohabitat units, based on velocity and depth relationships: slow and deep, slow and shallow, fast and deep, and fast and shallow. These relationships correspond to pools, glides, runs, and riffles, respectively. Differentiate these habitat types by the following characteristics:

- **Pool**: Pools are portions of the stream with reduced water velocity, deeper water than that found in surrounding areas, and a concave bottom forming a depression in the profile of the stream's thalweg which would retain water if there were no flow. Pools usually occur at outside bends (lateral scour) and around large obstructions (plunge pool). Pocket-water pools refer to groups of small pools often found in areas of otherwise fast or turbulent flow. These pools are usually caused by eddies behind boulders or other obstructions. Eddies are also associated with back-water pools. Water impounded upstream from channel blockage, typically caused by a log jam or beaver dam, is classed as a dammed pool. Another type of pool, a flat, is a wide, shallow pool often confused with a glide. Pools end where the stream bottom approaches the water surface, also known as the pool tailout.

- **Glide**: Glides are portions of the stream with slow-moving, relatively shallow water. Their surface has little or no turbulence and the stream bottom is flat, or slightly convex in shape, lacking the scour associated with pools. Glides are typically situated downstream of pools in the transition between the pool and the crest of the riffle. The riffle crest restricts water flow and slows the water in glides. Glides also occur where the channel widens, allowing the stream to become shallow and slow. Glides are most commonly found in low-gradient streams associated with elongated pools.

- **Riffle**: A riffle is a portion of the stream with swiftly-flowing, shallow water. The water's surface is turbulent. The turbulence is caused by completely- or partially-submerged obstructions, often the stream bottom. Cascades are one class of riffle characterized by swift current, exposed rocks and boulders, considerable turbulence, and stepped drops over steep slopes. Riffles that are swift, relatively deep, and have considerable surface turbulence (sometimes represented by standing waves) are called rapids. At high flow, rapids may be confused with runs.

- **Run**: A run is a portion of the stream with swiftly-flowing, relatively deep water which flows uniformly. There are no major flow obstructions to cause surface turbulence. Runs tend to occur immediately upstream and downstream of riffles. Pool tailouts are typically classed as runs in small, high-gradient streams. A narrow, confined channel through which water flows rapidly and smoothly, usually with a bedrock substrate, is called a chute. Chutes are a class of runs.

The classification of habitat units is geomorphic, flow-dependent, and may change with a change in discharge. It is recommended the observer "calibrate" his/her eye to the type of stream (e.g. spring creek, freestone creek) and local conditions; i.e., form a mental image of the various habitat types that should persist given the current conditions.

Determine the type of habitat units present along the longitudinal stream axis. Wetted portions of the main channel are assigned to one of the four habitat types. Complexes of multiple habitat units may be encountered. Individual habitat types should be recorded if the unit occupies more than 50% of the wetted channel width. Minor habitat units should be combined with the adjacent unit.

Large Organic Debris (LOD) (Q)

Method Reference: Platts et al. 1987, p. 83

Measurement Specifications: Count LOD greater than 10 cm in diameter and one meter in length; count in entire bankfull zone of influence (applicable only in forested areas).

Method Modifications: Occasionally, sites will be encountered with large accumulations of LOD. At these sites, it is acceptable to count up to 100 pieces and then estimate the remainder; i.e., if there are more than 100 pieces of LOD in the site, count the first hundred individually and count by tens thereafter.

Pool Quality (Q, S)

Method Reference: Bauer and Burton 1993, p. 119

Measurement Specifications: Take measurements in a minimum of four pools.

Method Modifications: Take both quantitative measurements (length, maximum width, maximum depth, depth at pool tailout, and residual depth) and subjective measurements (average substrate size, overhead cover, submerged cover, and undercut banks), using the correct code for each on the BURP field form.

Streambank Condition (S)

Method Reference: Platts et al. 1983; Bauer and Burton 1993, p.98

Measurement Specifications: Measured longitudinally (total stream site length) for both banks.

Method Modifications: Using a two-meter stick, tape, or hip chain, measure the total number of meters of stream bank that fall into each of four categories: covered and stable, covered and unstable, uncovered and stable, or uncovered and unstable. Stream banks are defined as covered if they are at least half-covered by perennial vegetation or roots, rocks of cobble size or larger, or logs greater than four inches in diameter. Banks are defined as unstable if they are fractured, slumping, sloughing, or vertical and eroded. Calculate the percent of the site characterized by each of the four bank conditions.

Habitat Assessment (S)

Method Reference: Hayslip 1993

Measurement Specifications: Visually evaluate the entire site. For streams with a riffle/run prevalence, estimate and record the appropriate codes for instream cover, embeddedness, channel shape, disruptive pressures, and zone of influence. For streams with a glide/pool prevalence, estimate and record the appropriate codes for all the above parameters as well as for pool substrate characteristics.

Summary Table for Wadable-Stream Core Parameters

Note: (M) = modified

Parameter	Method Reference	Type of Measurement (Q or S)
Photo Documentation	Cowley 1992 (M)	Q
Stream Channel Classification	Rosgen 1994 (M)	S
Temperature	Franson 1995	Q

Parameter	Method Reference	Type of Measurement (Q or S)
Discharge	Harrelson et al. 1994 (M)	Q
Macroinvertebrates	Clark and Maret 1993 (M)	Q
Fish	Chandler et al. 1993 (M)	S
Substrate	Wolman 1954 (M)	Q
Canopy Closure	Bauer and Burton 1993, p. 68 (M)	Q
Width and Depth	Bauer and Burton 1993, p. 86 (M)	Q
Habitat Distribution	Schuett-Hames et al. 1992 (M); Doloff et al. 1993 (M)	S
Large Organic Debris	Platts et al. 1987, p. 83 (M)	Q
Pool Quality	Bauer and Burton 1993, p. 119 (M)	Q, S
Streambank Condition	Platts et al. 1983 (M); Bauer and Burton 1993, p. 98 (M)	S
Habitat Assessment	Hayslip 1993	S

Recommended Procedure Sequence

1. Take pre-field steps to gather all existing chemical, physical habitat, and biological data residing with other federal and state agencies or entities, with the aim of identifying potential sampling sites.

2. Determine the appropriate site to survey in the field.

3. At the site, measure the appropriate distance and mark the beginning and ending points with flagging, being careful to stay out of stream. The downstream end of the measured length of stream is considered the beginning.

4. Take photographs of the site, record GPS coordinates, and record map location.

5. Fill out the descriptive cover sheet information, i.e., stream slope and Rosgen stream type, stream order, crew members' names, weather, location relative to some reference landmark, stream temperature (measured with a thermometer), general observations, etc.

6. Measure stream discharge.

7. Locate the first riffle upstream from beginning point.

8. Take a macroinvertebrate sample.

9. Conduct fish sampling (electrofishing, et cetera) if it is to be done.

10. Conduct a pebble count immediately upstream from the macroinvertebrate sample transect.

11. Take canopy closure (shade) measurements at the riffle habitat unit transect where macroinvertebrates were sampled.

12. Measure width and depth of the stream 10 meters above the riffle habitat unit transect where macroinvertebrates were sampled.

13. Proceed to a mid-site riffle habitat unit and repeat macroinvertebrate sample, pebble count, canopy closure, and width/depth measurements

14. Proceed to a upper-site riffle habitat unit and repeat macroinvertebrate sample, pebble count, canopy closure, and width/depth measurements

15. Conduct habitat distribution measurements. Express this on the field forms by percent of total length surveyed.

16. Assess pool quality at a minimum of three pools within the site. Follow the pool definition described under "Habitat Types" in selecting pools.

17. Conduct a streambank-condition survey. Express ratings as percentages.

18. Complete the habitat assessment summary sheet.

Chapter 4: Large-River Methods

The following set of methods is a compilation of modified ISU and NAWQA protocols. The Division of Environmental Quality River Technical Advisory Committee (RTAC), which includes representatives from the DEQ central office and regional office technical staff, reviewed and modified the protocols to provide reconnaissance methods appropriate for large rivers. The methods will be revised as necessary to ensure BURP goals and objectives are achieved.

Pre-Monitoring Steps

Large-River Selection

As noted earlier, Idaho must meet TMDL requirements within a short time frame. With this in mind, the following rivers are given priority for monitoring in order to address current BURP goals:

1. water-quality limited rivers [per Idaho 1996 §303 (d) list];
2. large rivers located in a sub-basin assessment; and
3. large rivers that may provide reference conditions.

Existing Data Review

(See Chapter 3, Existing Data Review)

Site Selection

One of the factors that contributes to the complexity of large rivers is the multiple spatial scales which influence the chemistry, physical nature, and biology of these water bodies. The BURP process partially addresses this issue by using methods that combine information from different scales, such as GIS data bases, topographical maps, and in-stream data. Sampling locations must be chosen carefully to obtain representative data for beneficial-use status determinations.

The first step is to select a sampling site. The sampling site should include at least two examples each of two different habitat types (i.e., 2 riffles + 2 pools, 2 runs + 2 glides, etc.). Since these habitat types describe channel shape and scour patterns (Meador et al. 1993), BURP crews need to ensure that various erosional and depositional areas are represented. In addition, at least one sampling site should be located on each § 303(d) listed segment. All segments should include a sufficient number of sites to fully characterize the condition of the river.

Many large-river sampling sites may only have one habitat type, such as a run. When this occurs, the length of the sampling site should be 20 times the channel width or 500 m, whichever is smaller. The channel width within the site should be representative of the stream (Robinson and Minshall 1995).

The following are other recommendations for accomplishing representative sampling:

- The regional office contact should plan the field monitoring effort before it begins. Such planning may include conferring with other resource agency representatives, examining existing data, and investigating maps and aerial photographs to provide the basis for sampling site selection. Factors that may influence the stream site, such as tributaries and man-made structures or channel alterations, should be investigated during this phase (DEQ 1996 a).

- The regional office contact should visit or research potential sites to determine accessability, boat ramp availability, and sampling equipment requirements (Robinson and Minshall 1995).

- The sampling site should be located near a USGS gaging station, if possible, to provide information such as discharge data (Robinson and Minshall 1995).

- The sampling site should allow sampling to be performed on a minimum of 500 m of the river (Meador et al 1993).

After identifying the sampling site, select six equidistant transects along the site. Choose these transects to represent the reach. Crews should begin downstream and work upstream unless this procedure is too time consuming due to river conditions. Idaho State University crew members worked upstream to downstream in some large rivers and found no evidence of this affecting the data (Royer, personal communication, 1997).

Criteria for Using the Large River Methods

The field season will occur from September to November, when most rivers are at base flow, to facilitate sampling efforts and limit safety problems. Some rivers may be wadable at this time, but still require the large river methods. One of the following criteria must be met in order for the large river methods to be used:

1. Less than the entire sampling site is safely wadable.
2. The entire set of methods for wadable streams cannot be performed.

Core Parameters

Like the wadable-stream program, the large-river monitoring program calls for the collection of chemical, physical, and biological data. There is an emphasis, however, on quantitatively sampling biological assemblages such as algae, macroinvertebrates, and fish. These biological communities, which represent different trophic levels, are sensitive to cumulative impacts in the aquatic environment and are used as indicators of water quality. The U.S. Environmental Protection Agency recommends the measurement of biological integrity as the best approach to identifying environmental indicators of surface waters (Davis and Simon 1995).

Some of the physical measures listed below, such as floodplain disturbance and riparian vegetation, were selected to provide information about land-use activities that might impact water quality. Other parameters such as discharge and width/depth provide descriptive information of the river system. This information will be useful in interpreting and evaluating biological data results.

A “Q” indicates that the parameter is quantitatively measured, while an “S” indicates that the parameter is subjectively, or qualitatively, measured.

Fecal Coliform (Q)

Method Reference: Standard Methods 9060 A., 9222 D. (Franson 1995)

Measurement Specifications: Use existing data if collected within last five years. If unavailable, collect a minimum of one field sample during recreational season (May through September).

Method Modifications: Collect as close to the main stream (thalweg) as possible by wading, boating, or using a sampling device from a bridge. Avoid sampling from banks and in slack water. If sampling is performed from a bridge, take the sample from the upstream side (Ralston and Browne 1976).

Collect in a sterile (auto-claved), 250-ml Nagelene™ bottle treated with sodium thiosulfate ($NA_2S_2O_3$). Dip the bottle into the flowing water, allowing for a 1/4-inch air gap between the waterline and neck of the bottle. Do not rinse the bottle before sampling and do not remove the cap until sampling.

Submit all samples to the designated laboratory within 24 hours of collection. Place the samples on ice and cool them to approximately 4°C for transportation. If necessary, store samples in a sample-storage refrigerator at the nearest DEQ regional office.

Photo Documentation and Diagrammatic Mapping (S)

Method Reference: Meador et al. 1993

Measurement Specifications: Take three photographs at each transect (1-6); take one photo facing upstream, one perpendicular to channel, and one downstream from left or right bank. Measure azimuth of each photo. Draw a representative map of the site.

Method Modifications: Photograph stream conditions at each transect using slide film and date back cameras. The azimuth of the camera lens is measured with a compass. Use a dry-erase board or another type of sign in the photograph to provide a scale of reference, pertinent location information, and facilitation of repeat photographs.

Temperature, Hydrogen Ion Concentration (pH), Dissolved Oxygen, Conductivity (Q)

Method Reference: Hydrolab Corp. 1993

Measurement Specifications: Measure each parameter at transect 1 using a Hydrolab© unit.

Water Clarity (S)

Method Reference: Robinson and Minshall 1995

Measurement Specifications: Note clarity at transect 1.

Method Modifications: Describe clarity of water as very turbid, turbid, slightly turbid, or clear.

Width and Depth (Q)

Method Reference: Robinson and Minshall 1995

Measurement Specifications: Measure width of wetted channel, width of bankfull channel, and height from water surface to bankfull at transects 1-6. Measure depth at 20 equidistant locations.

Method Modifications: Measuring at 20 equidistant locations along the transects is optimal, but measuring at 10 to 20 equidistant locations is acceptable if the sampling site is extremely narrow. Measure depth along the transects where macroinvertebrates are collected.

Streambank Condition and Material Types (S)

Method Reference: Meador et al. 1993

Measurement Specifications: Estimate streambank condition and material types at transects 1-6.

Method Modifications: Estimate percent of bank stability from the water edge to bankfull. Perform the qualitative measurement for each transect range and record according to the categories developed for the NAWQA stream habitat protocol (Meador et al. 1993).

For bank material types, identify the spatially dominant and subdominant bank material types within 2 m of each transect to the top of each bank (normal high-water line). Use the percentage categories developed for the NAWQA stream habitat protocol to rate these categories of materials (Meador et al. 1993).

Channel Alterations (S)

Method Reference: Meador et al. 1993; US EPA 1996a

Measurement Specifications: Note codes of all types of channel alterations at transects 1-6.

Method Modifications: DEQ will modify the codes as necessary to identify important channel-alteration features.

Substrate and Embeddedness (S)

Method Reference: Robinson and Minshall 1995

Measurement Specifications: Estimate substrate size at 20 equidistant locations.

Method Modifications: Although sampling substrate at 20 equidistant locations along the transects is optimal, sampling at 10-20 equidistant locations is acceptable if the sampling site is extremely narrow. Visually estimate and record the size of substrate along the three transects where macroinvertebrates are collected. In turbid, wadable waters, determine substrate size by touch. In nonwadable waters, use a substrate probe (metal, hollow rod in 10-ft. sections) to evaluate substrate size (Robinson and Minshall 1995).

For embeddedness, visually estimate and note the percent of bottom covered or surrounded by fine sediment at the locations where macroinvertebrates are collected. As a last resort, a Petite Ponar can be used to obtain substrate samples where visual estimation cannot occur due to high water depth or turbidity.

Aquatic Macrophytes (S)

Method Reference: Robinson and Minshall 1995

Measurement Specifications: Note macrophyte cover at 20 equidistant locations along the three transects where macroinvertebrates are collected.

Method Modifications: Randomly select substrate to record attachment of aquatic macrophytes. Although measuring macrophytes at 20 equidistant locations along the transects is optimal, 10 to 20 equidistant locations is acceptable if the sampling site is extremely narrow. Perform water depth, substrate size, and macrophyte cover measurement concurrently (Robinson and Minshall 1995).

Macroinvertebrates (Q)

Method Reference: Meador et al. 1993; Robinson and Minshall 1995

Measurement Specifications: Collect three samples at each of the three most physically-different habitats, or at transects 1, 3, and 6 if habitat is uniform. Use a Slack sampler with a 500-µ mesh, or a Petite Ponar if conditions preclude use of the Slack sampler.

Method Modifications: Composite samples per transect; preserve and store them separately in the field. Laboratory personnel will composite the three samples, count, and identify the first 500 individuals.

Periphyton (Q)

Method Reference: Porter et al. 1993

Measurement Specifications: Collect three samples at the three most physically different transects or transects 1,3, and 6 if habitat is uniform. Use SG-92 devices.

Method Modifications: Composite samples per sample site; preserve and store them in the field. Laboratory personnel will count and identify a minimum of 300 individuals.

Habitat Distribution (S)

Method Reference: Robinson and Minshall 1995

Measurement Specifications: Note habitat types (riffle, run, pool, glide) throughout sampling site. (See pp. 28-29 for description of habitat types).

Method Modifications: Estimate the percentage of each habitat type for entire sampling site.

Riparian Vegetation (S)

Method Reference: Robinson and Minshall 1995; Bahls 1996

Measurement Specifications: Answer questions asked on BURP field form for entire site.

Method Modifications: To assess the condition of the riparian vegetation, visually estimate the predominant vegetation, identify recognizable species, evaluate the riparian zone condition, and note the extensiveness of the zone according to qualitative questions asked on the field form.

Floodplain Disturbance (S)

Method Reference: none

Measurement Specifications: Review aerial photos or GIS coverage of a 10-mile section of the river centered on the sampling site. To ground truth, perform field observations of land use in the floodplain area.

Method: Use aerial photos or GIS coverages, if available, to estimate the percentage of the natural floodplain that is disturbed by land-use features such as roads or agricultural fields. Observe and record floodplain disturbance in the field to ground truth interpretations of the land-use coverages. Observe the floodplain and note uncultivated and naturally-occurring riparian vegetation such as trees, shrubs, and grassy meadows.

Discharge and Gradient (Q or S)

Method Reference: Robinson and Minshall 1995

Measurement Specifications: Collect data from outside sources. If unavailable, measure at transect 1 in safely-wadable conditions. Determine the gradient of the sampling site using a topographical map.

Method Modifications: It may be too time-consuming to measure discharge in rivers, particularly in nonwadable waters. Consequently, you should first review existing USGS data collected near the sampling site to obtain discharge data. If USGS data is unavailable and the site is wadable, then measure discharge according to ISU protocol (Robinson and Minshall 1995). If neither option is feasible, use historical data.

Fish (Q)

Method Reference: Idaho Department of Fish and Game (IDFG) Approved Fish Collection Protocol (to be determined)

Measurement Specifications: Use existing data collected by outside sources (IDFG, USFWS, etc.). If no fish data for the river exists, coordinate with IDFG to collect fish community data in the field.

Method Modifications: It is the regional office's responsibility to acquire fisheries data. If the existing data is insufficient, coordinate with the IDFG regional offices to determine sampling needs. DEQ and IDFG will determine protocols for additional data collection prior to sampling activities.

Summary Table for Large-River Core Parameters

Note: (M) = modified

Parameter	Method Reference	Type of Measurement (Q or S)
Fecal Coliform	Franson 1995 (M)	Q
Photo Documentation	Meador et al. 1993 (M)	S
Temperature, pH, Dissolved Oxygen, Conductivity	Hydrolab Corp. 1993	Q
Water Clarity	Robinson and Minshall 1995 (M)	S
Width and Depth	Robinson and Minshall 1995 (M)	Q
Streambank Condition and Material Types	Meador et al. 1993 (M)	S
Channel Alterations	Meador et al. 1993 (M); US EPA 1996a (M)	S
Substrate and Embeddedness	Robinson and Minshall 1995 (M)	S
Aquatic Macrophytes	Robinson and Minshall 1995 (M)	S
Macroinvertebrates	Meador et al. 1993 (M); Robinson and Minshall 1995 (M)	Q
Periphyton	Porter et al. 1993 (M)	Q
Habitat Distribution	Robinson and Minshall 1995 (M)	S
Diagrammatic Mapping	Meador et al. 1993	

Parameter	Method Reference	Type of Measurement (Q or S)
Riparian Vegetation	Robinson and Minshall 1995 (M); Bahls 1996 (M)	S
Floodplain Disturbance	none	S
Discharge	Robinson and Minshall 1995 (M)	Q or S
Gradient	none	Q
Fish	To be determined	Q

Recommended Procedure Sequence

The following procedures will be performed by the statewide crew members unless "RO" is noted, which indicates that the regional office contact should perform the task.

1. Perform pre-field steps to gather existing chemical, physical, and biological data (RO). It is particularly important to gather existing discharge, fish, and bacteria data at this stage.

2. Coordinate monitoring efforts (e.g. fish or bacteria) with federal, state, and local government agencies or entities (RO).

3. Perform site selection reconnaissance by mid-August (RO).

   In the office:
   - Identify USGS gaging stations on maps.

   In the field:
   - Take general notes on the habitat (in-channel and riparian) and structures within the river that may influence the sampling procedures or results.
   - Note accessability, boat ramp availability, and nearby camping facilities.

- Recommend necessary sampling equipment (e.g. boat and macroinvertebrate) after evaluating predominant substrate and water depth.
- Collect a fecal coliform sample (May - September).
- Take a photo of transect 1 and note the map location.
- Estimate the time and mileage required to drive to site from known location (i.e., DEQ office).

4. Record the GPS coordinates and map location (these should correspond to site reconnaissance location).

5. Fill out the descriptive cover-sheet information.

6. At transect 1, take photographs and record information on field form.

7. Measure water quality parameters with a Hydrolab© at transect 1. Calibrate the instrument weekly.

8. Note water clarity at transect 1.

9. Measure the wetted width, bankfull width, and bankfull height for the left and right banks at the transect.

10. Estimate the percentage of bank stability and record the percentage code for the left and right banks at the transect.

11. Estimate bank material types and record the percentage code for the left and right banks at the transect.

12. Identify channel and bank alterations at the transect and record codes. Describe the various water-management features in the space provided, if applicable.

13. Repeat steps 6-12 for all the remaining transects.

14. Measure water depth at a minimum of 10 intervals (20 intervals are optimal) at the first transect where macroinvertebrates are collected. At each interval, visually estimate and record the substrate size, if possible. Also, indicate macrophyte attachment.

15. Repeat step 14 for the other two transects where macroinvertebrates are collected.

16. Take the macroinvertebrate sample from the right, left, and center of the channel.

17. Visually estimate the percent embeddedness at the transects where macroinvertebrates are sampled, if possible, and record the percentage category.

18. Take the periphyton sample at the fist transect where macroinvertebrates are sampled. Record the category of periphyton abundance.

19. Repeat steps 16-18 at the other two most physically different transects or transects 3 and 6 if uniform conditions exist.

20. Estimate the longitudinal habitat distribution.

21. Sketch a representative map of the site.

22. Answer the riparian vegetation questions on field form for the entire site.

23. Determine the percent of floodplain disturbance from aerial photos or GIS maps (RO).

24. Determine the gradient from a map (RO).

25. Complete any additional coordinated monitoring (e.g. fish or bacteria).

Chapter 5: Lake-and-Reservoir Methods

Pre-Monitoring Steps

Water Body Selection

The following selection criteria are recommended in order to address current agency goals:

- water quality-limited lakes and reservoirs [per Idaho 1996 §303(d) list];
- lakes and reservoirs with little or no monitoring information;
- lakes and reservoirs with reference conditions; and
- lakes and reservoirs previously intensively sampled (*e.g.* Clean Lakes Program).

Inclusion of previously sampled waters aids in the evaluation of the usability of these data. This is accomplished by comparing reconnaissance-level assessments with findings from the previously conducted intensive studies.

Existing Data Review

(see Chapter 3, Existing Data Review)

Site Selection

In order to properly assess beneficial uses of water bodies, we must group similar waters so that comparisons can be made in kind (Conquest et al. 1994). Professional judgement is used in order to arrive at a workable system of classification, and this system is taken into account when choosing lake and reservoir sites for BURP monitoring. Classification should ensure that variability of the measures within each class is minimized and that the variability among classes is maximized (Scheaffer et al. 1986). The classification scheme must reflect inherent properties of lakes and reservoirs which are independent of human influence (*e.g.* size, depth) so that waters can be assigned to a class before measures are taken. Ultimately, the classifications should reflect real differences in

measurements. The following classification scheme is proposed:

Ecoregion or Geographic Zone-Surface Area/Watershed Size-Depth-Basin or Zone-Site.

One classification variable often used for streams is ecoregion. Ecoregions, however, may be less applicable for lakes and reservoirs because these water bodies are catchments for large watersheds often draining more than one ecoregion. A possible classification scheme for lakes and reservoirs involves combinations of ecoregions: a northern, montaine forest ecoregion versus a southern, plains sagebrush/grassland ecoregion, for example. Other states have successfully incorporated geographic zones for water body classification (U.S. Environmental Protection Agency 1991).

As mentioned, water-body classifications should strive to group similar waters. Thornton et al. (as cited in Ryding and Rast 1989) found natural lakes generally have smaller watersheds than reservoirs. This is important since lakes and reservoirs are integrators of their watershed and thus affect chemical, physical, and biological measures. Milligan et al. (1983) classified Idaho waters, in part, on surface area and watershed size. These factors were combined to address the concept of these waters' being integrators of their watersheds: a reservoir with a large watershed should behave differently than a lake with a small watershed. The surface-area-to-watershed-size ratio for the population of waters sampled by Milligan et al. (1983) was significantly different ($P < 0.05$) between lakes and reservoirs. Waters monitored under BURP will be classified according to their surface-area-to-watershed-size ratio. Small ratios will typically depict reservoirs. Hydraulic residence time has also be shown to represent real differences between lakes and reservoirs (Thornton et al. as cited in Ryding and Rast 1989), but knowledge of water body volume and hydrologic budgets are needed to calculate this variable. The later of these data are extremely costly and time consuming to collect and are not likely to be available from a reconnaissance-level monitoring effort.

Milligan et al. (1983) used depth to classify waters. Lakes and reservoirs with a maximum depth greater then 18 m were classified as deep; other waters were classified as shallow. Depth is important because deep waters tend to stratify, thus isolating bottom waters. Mossier (1993) and Lockhart (1995) reported thermocline depths generally between about five and ten meters. Others measured thermoclines as deep as 15 -20 m (Bellatty 1990, Woods 1991, Cobb et al. 1995, Idaho Department of Health and Welfare 1997b).

Lakes and reservoirs may exhibit distinct areas. Most lakes have a single basin and thus will consist of a single unit. Larger lakes may have basins and reservoirs may have zones that are morphologically or hydrologically different. Each basin may be considered a separate unit because of restricted water flow. Different zones represent flowing, river-like conditions; transitional conditions; and lacustrine, lake-like conditions near a dam. Additional basins and zones should be sampled if one site is insufficient to adequately characterize the chemical, physical, and biological conditions of the waters. No more than three units per water body, each consisting of pelagic and littoral sites, should be monitored.

Sites are thought of as samples of the larger homogenous unit. Pelagic sites will typically be located at the maximum depth. Representative sites may be more appropriate for reservoir riverine zones. Littoral sites will include either a public swimming area or boat launch, a representative least-impaired shoreline, a representative impaired shoreline, and near the major inlet.

Sampling Regime
Field sampling is scheduled in the period from July to September in order to obtain representative measures of lake and reservoir conditions during critical high temperature, maximum production, and low flow. The goal is to monitor each water body as close as possible to its annual peak biotic activity. A schedule was established to sample high-elevation and -latitude lakes and reservoirs in August and others with broader activity peaks sometime from July to early September.

Criteria for Using Lake and Reservoir Methods

Lakes are easily identifiable, however, reservoirs may be confused with large rivers. Certain criteria distinguish lakes from small ponds and wetlands and reservoirs from riverine pools. Open water with a surface area greater than one hectare will characterize lakes. Thornton (1990) reported hydraulic residence time in reservoirs is greater than 14 d. (This criterion should be estimated if hydraulic residence time is unknown.) Waters that meet these criteria will then be candidates for monitoring using the lake and reservoir methods, otherwise large river methods will be used.

Core Parameters

The lake-and-reservoir methods call for the collection of chemical, physical, and biological data to be used in determination of beneficial-use support status. There

is an emphasis placed on quantitative (Q) chemical and biological measures. Physical measures tend to be qualitative, or subjective (S).

Note: Macrohabitat shorezones--as referenced in Shoreline Physical Habitat Characterization, Periphyton, Aquatic Macrophytes, Littoral Bottom Substrate, Photo Documentation and Diagrammatic Mapping, and Macroinvertebrates--should represent least-impaired, impaired, major inlet, and either public-swimming or boat-launch areas.

Bathymetry or Depth (Q)

Method Reference: Hamilton and Bergersen 1984

Measurement Specifications: Measure maximum depth at regular intervals along evenly-spaced transects.

Method Modifications: Locate multiple transects representing a grid pattern to generate a depth-contour map of the water body. Record the latitude and longitude and compass heading of your position using the Global Positioning System (GPS) and compass at the beginning of each transect. Measure maximum depth using a fathometer at regular intervals along each transect. Regular intervals are determined by set intervals on a stop watch. Record your position using GPS at the end of each transect.

Water Clarity (Q)

Method Reference: Hamilton and Bergersen 1984

Measurement Specifications: Measure Secchi depth at pelagic sites.

Temperature, Dissolved Oxygen, Hydrogen Ion Concentration (pH), Conductivity (Q)

Method Reference: Woods 1991

Measurement Specifications: Measure parameter depth profiles at pelagic sites.

Method Modifications: Measure water temperature, dissolved oxygen, pH, and conductivity using a Hydrolab© or other similar multiparameter probe. For sample sites with a total depth less than 15 meters, record at 1-meter depth intervals. For sample sites with a total depth greater than 15 meters and unstratified conditions, record at 5-meter depth intervals. In stratified waters greater than 15 meters in total depth, record at 1-meter depth intervals through the thermocline and then at 5-meter depth intervals for up to 30 meters of depth. For the remainder of the depths (depths greater than 30 meters), record at 10-meter depth intervals. Make an additional measurement at one meter off the bottom in waters more than 15 meters deep.

Nutrients (Q)

Method Reference: Bellatty 1990

Measurement Specifications: Collect water samples at pelagic sites. Composite water samples from five, equally-spaced depth intervals in the euphotic zone of stratified waters, or throughout the water column in unstratified waters. Composite samples from two samples collected one meter off the bottom in stratified waters.

Method Modifications: Sub-samples are filtered and preserved depending on specific nutrient constituents. In stratified waters, composite five 2.2-L Van Dorn (or other similar horizontal bottle) samples taken at equally-spaced depth intervals in the euphotic zone (2.5 x Secchi depth), one immediately below the surface. In unstratified waters, composite five 2.2-L Van Dorn bottle samples taken at equally- spaced depth intervals, one immediately below the surface. Mix the samples thoroughly in a 14-L polyeurethane container.

Rinse a 1-liter cubitainer and lid twice with sample water. Draw a 1-liter sub-sample preserved with 2 milliliters of concentrated sulfuric acid.

Filter a 0.5-L sub-sample using a standard millipore (0.45-µ) hand-operated vacuum filter apparatus. Rinse a one-liter cubitainer and lid twice with filtered sample water. Transfer the sub-sample to the cubitainer.

Filter a 1-liter sub-sample using a standard millipore (0.45-µ) hand-operated vacuum filter apparatus. Rinse a 1-liter cubitainer and lid twice with filtered sample water. Transfer the sub-sample to the cubitainer and preserve with two milliliters of concentrated sulfuric acid. Chill all sub-samples to four degrees centigrade.

Repeat the process with two 2.2-L Van Dorn or other similar horizontal bottle samples taken one meter off the bottom in stratified waters.

Chlorophyll *a* (Q)

Method Reference: Bellatty 1990

Measurement Specifications: Collect water samples at pelagic sites. Composite water samples from five equally-spaced depth intervals in the euphotic zone of stratified waters, or throughout the water column in unstratified waters.

Method Modifications: In stratified waters, composite five 2.2-L Van Dorn (or other similar horizontal bottle) samples taken at equally-spaced depth intervals in the euphotic zone (2.5 x Secchi depth), one immediately below the surface. In unstratified waters, composite five 2.2 L Van Dorn bottle samples taken at equally spaced depth intervals, one immediately below the surface. Mix samples thoroughly in a 14 L polyeurethane container. Filter a one-liter sub-sample using a 0.7-µ glass fiber filter and a hand-operated vacuum filter apparatus at 20-30 psi under a boat canopy. Add one milliliter of magnesium carbonate with 10-ml filtrate left. Place filter in petri dish, wrap in aluminum foil, and chill to four degrees centigrade.

Phytoplankton (Q)

Method Reference: Bellatty 1990

Method Modifications: Describe the community's growth (not visible, sparse and thin, moderate, or dense) and form (short stature, stems visible and not reaching waters surface, stems overlapping waters surface, or floating). Using an underwater viewbox, conduct the assessment at one, two, and three meters distance from shore at three, evenly-spaced transects in a 150-m horizontal shoreline reach. Collect milfoil (*Myrophyllium* sp.) if observed at either public-swimming or boat-launch areas. Chill the sample to four degrees centigrade.

Littoral Bottom Substrate (S)

Method Reference: Kaufman and Whittier 1997

Measurement Specifications: Record the percent dominant substrate size at each macrohabitat shorezone per lake basin or reservoir zone.

Method Modifications: Using an underwater viewbox, conduct the assessment at one, two, and three meters distance from shore at three, evenly-spaced transects in a 150-m horizontal shoreline reach.

Photo Documentation and Diagrammatic Mapping (S)

Method Reference: U.S. Environmental Protection Agency 1997

Measurement Specifications: Take photographs in the littoral zone at each macrohabitat shorezone per lake basin or reservoir zone.

Method Modifications: Using an underwater viewbox, conduct the assessment at one, two, and three meters distance from shore at three, evenly-spaced transects perpendicular to the shore in a 150-m horizontal shoreline reach. Diagrammatically map the pelagic depth profile sites and the macrohabitat shorezone sites.

Macroinvertebrates (Q)

Method Reference: Kinney et al. 1997

Measurement Specifications: Collect grab samples from the soft substrata in the sublittoral zone or 2.5 x Secchi depth at each macrohabitat shorezone per lake basin or reservoir zone.

Method Modifications: Use a Petite Ponar dredge to collect samples. Sieve samples through a standard 500-μ screen. Place the sample into a container, label inside and outside, and preserve with 70% ethanol (container should be one-half to one-third full). Contents should be divided into two containers if the original

container is more than half-full of sample material. The first 500 individuals will be counted and identified to the lowest taxonomic level (tribe for Chironomids).

Fish (Q or S)

Method Reference: none

Measurement Specifications: Use existing data collected by other sources (e.g., Idaho Dept. Of Fish and Game, academic institutions). Coordinate with IDFG to collect fish if no data exists.

Fecal Coliform (Q)

Method Reference: Sylvester et al. 1990

Measurement Specifications: Collect sample(s)at either a public swimming area or boat launch. Coordinate with the DEQ Regional Office or local Health District office.

Summary Table for Lake-and-Reservoir Core Parameters

Note: (M) = modified

Parameter	Method Reference	Type of Measurement (Q or S)
Bathymetry or Depth	Hamilton and Bergersen 1984 (M)	Q
Water Clarity	Hamilton and Bergersen 1984	Q
Temperature, Dissolved Oxygen, pH, Conductivity	Woods 1991 (M)	Q
Nutrients	Bellatty 1990 (M)	Q
Chlorophyll *a*	Bellatty 1990 (M)	Q
Phytoplankton	Bellatty 1990	Q
Shoreline Physical Habitat Characterization	Kaufman and Whittier 1997 (M)	S
Periphyton	Kaufman and Whittier 1997 (M)	S
Aquatic Macrophytes	Kaufman and Whittier 1997 (M)	Q
Littoral Bottom Substrate	Kaufman and Whittier 1997 (M)	S
Photo Documentation and Diagrammatic Mapping	US EPA 1997 (M)	S
Macroinvertebrates	Kinney et al 1997 (M)	Q
Fish	none	Q or S
Fecal Coliform	Sylvester et al. 1990	Q

Recommended Procedure Sequence

1. Conduct pre-field steps to gather existing chemical, physical, and biological data. Coordinate monitoring efforts (*e.g.* fish or bacteria) with federal, state, and local governmental agencies or entities.

2. Generate a bathymetric map if none exists. (This is very time consuming, so making exhaustive efforts to find existing maps is highly recommended.) Survey for appropriate pelagic and macrohabitat shorezone sites while recording depths or if a bathymetric map already exists.

3. Select the maximum depth or representative reservoir riverine location. Anchor the boat.

4. Measure water clarity.

5. Measure water-quality parameter depth profiles with the Hydrolab©.

6. Collect water samples. Draw, filter, and preserve appropriate water sub-samples for nutrient constituents. Filter water sub-sample for chlorophyll *a*. Draw a water sub-sample for phytoplankton speciation. Chill all samples to four degrees centigrade.

7. Collect two water samples from one meter off the bottom in stratified waters. Draw, filter, and preserve water sub-samples for nutrient constituents. Chill all samples to four degrees centigrade.

8. Repeat preceding procedures at all pelagic sites.

9. Select macrohabitat shorezone. Complete shoreline physical habitat characterization. Describe the periphyton and macrophyte community and the littoral bottom substrate. Collect milfoil (*Myrophyllium* sp.) if observed at either public swimming or boat launch areas. Photograph littoral zone.

10. Collect sublittoral macroinvertebrate samples. Sieve and preserve.

11. Repeat preceding procedures at all macrohabitat shorezones.

12. Map monitoring sites.

13. Complete any additional coordinated monitoring (*e.g.* fish or bacteria).

Chapter 6: Quality Assurance

Primary Quality-Assurance Efforts

Collection of reliable and accurate monitoring and measurement data is the goal of the quality assurance (QA) aspect of the BURP process. The four main components of DEQ's quality-assurance program, aimed at enhancing reliability, accuracy, and consistency are: 1) crew supervision; 2) regional BURP coordinator workshops; 3) regional crew training; and 4) field reviews.

Crew Supervision

Wadable Streams

Each BURP crew is provided with supervision throughout the monitoring season. The regional BURP coordinators are involved during the training period and then accompany crews at least one day per week throughout the monitoring season. Coordinators are trained annually through the coordinator workshop where they are refreshed on procedures, learn new methods, and exchange ideas on data collection efficiency and accuracy.

Large Rivers, Lakes, and Reservoirs

One crew performs the large river, lake, and reservoir monitoring statewide. This arrangement requires fewer resources (equipment, personnel, etc.), increases efficiency, and reduces sampling inconsistencies. The DEQ central office supervises the state crew throughout the data-collection season. A minimum of one regional-office contact accompanies the crew while it is in his/her region.

Regional BURP Coordinator Workshop

Wadable Streams

A coordinator workshop is conducted prior to each monitoring season. The workshop provides:

- transfer of training materials and instruction methods;
- training on new methods; and
- statewide consistency of monitoring methods.

The DEQ central office staff coordinates and facilitates this workshop. Each DEQ regional BURP coordinator and central office BURP staff member is randomly assigned parameters to present. Presentations include:

- a copy of the relative sections of referenced methods;
- printed recommendations of training methods; and
- an example of properly recorded measurements.

The materials presented at this workshop are combined into an annual reference document that is used in regional crew training. Regional crew instruction includes training on all the existing BURP methods, plus new or modified methods.

Large Rivers

There are two separate training sessions concerning large rivers. The first session trains BURP coordinators and central office staff in river-site selection. Idaho State University performs most of this training to ensure that their experience is transferred to DEQ. The training covers sampling site selection, transect designation, USGS gaging station location, accessability determination, boat-ramp availability, and sampling-equipment requirements. The training is held in late spring or early summer. The second session is described under Crew Training (below).

Crew Training

Safety Training (All Crews)

All BURP crew members, regional coordinators, and central office technical team staff will be trained and certified in cardio-pulmonary resuscitation. This requirement will increase safety during electrofishing, training, and BURP field work. The BURP crews can be trained by DEQ trainers, or certification can be a hiring requirement. For detailed information on electrofishing safety procedures, see Appendices VIII-X; for detailed information on safe handling of formalin, see Appendix XII.

Additional safety requirements include competent boat handling and swimming skills for Large River, Lake and Reservoir crews.

Wadable-Streams Methods

Following the coordinator workshop, the regional coordinators will conduct training of crews within their regions. The regional crew training covers all aspects of the BURP process whether training is a refresher for veteran crew members or first-time for new crew members. Training provides a chance for hands-on experience with each parameter and monitoring method for all BURP crew members. Regional crew training lasts at least two days, including one day in the classroom and one day in the field.

Large-River Methods

A training workshop for central office contacts, regional office contacts, and crew members will be conducted. For the first year, DEQ will develop training in consultation with ISU to transfer their large-river monitoring knowledge and experience to DEQ. The workshop will include training materials, method instruction, field instruction, and safety instruction.

Lake and Reservoir Methods

The state lake and reservoir crew will receive training concurrent with the coordinators'. Training provides a chance for hands-on experience in each parameter. Training requires at least three days, including one day in the classroom and two days on a water body implementing the methods.

Field Audits

Wadable Streams (Site Replication Workshop)

In order to maintain quality assurance, gain insight into the variability among crews, and to identify major sources of data variability, the Site Replication Workshop was developed for 1997 to replace field reviews for crews monitoring wadable streams.

The Site Replication Workshop produces replicate site data gathered by different crews which is used to identify sources of sampling variability. Once a source of variability is identified, the BURP coordinators work with crews to correct deviations from procedure or modify monitoring methods to reduce the variability. The workshop occurs two weeks after the crews receive their training. At the workshop, all BURP crews monitor sites within the specified stream reach. Regional coordinators can then use this workshop's results to evaluate their crews and implement further training to decrease the variability of specific monitoring methods.

Large Rivers, Lakes and Reservoirs

DEQ's designated contacts will observe the state crew measure, collect, and preserve field data. The field audit is held within two weeks of the workshop training. The purpose of the audit is to ensure that the data collected is consistent and reliable for assessment of beneficial uses. The DEQ contacts will provide feedback to the crew and additional training, if necessary.

Other Quality-Assurance Efforts

Equipment Maintenance

The BURP crews will preform routine maintenance and calibration of all meters. Electronic sensors, such as Hydrolab© multiparameter probes, will be calibrated weekly in accordance with the manufacturers' instructions and will follow the outlined procedures in the equipment manuals. Flow meters will be checked for zero flow monthly, following the procedures in the flow meter manuals. The regional BURP coordinator will log all sensor-maintenance and calibrations for the assessment of wadable streams. The state crew will be responsible for those used for the assessment of large rivers, lakes, and reservoirs.

Sample Collection

BURP crews, in cooperation with the regional office contacts and the state laboratory, will perform quality-assurance measures to insure the collection of scientifically defendable data. These measures include taking "blank" samples and/or collecting duplicate samples. The number of quality-assurance samples should equal, at minimum, 5 to 10% of the total number of samples (American Public Health Association 1995). Blanks will be treated as regular samples. Ordinary water will be taken into the field, transferred to an empty sample container, and labeled "BLANK". This water will be filtered, just as sample water would be filtered, in order to duplicate all aspects of the original sample collection. Duplicate samples analyzed by the laboratory in order to assess the precision of the data. Duplicate samples will be taken from the same water body and will be collected and processed in the same manner as the original sample.

Further information on laboratory QA is addressed in the "request for proposal" for macroinvertebrate and fish identification. Contact the Idaho Bureau of Laboratories (208-334-2235).

Data Handling

Specifics of the QA for data handling can be found in *Procedures and Guidelines for QA/QC of 1997 Beneficial Use Reconnaissance Project (BURP) Data* (DEQ 1997). Generally, the QA process requires review of data sheets by DEQ central office QA crew and data entry by DEQ's Information Services Bureau.

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Glossary

abiotic - An adjective applied to the non-living, physical, and chemical components of an ecosystem, as distinct from the biotic or living components.

anoxic - Greatly deficient in oxygen.

attainable use - A beneficial use that, with improvement, a waterbody could support in the future.

beneficial use - Any of the various uses of water; these include, but are not limited to, water supply (agricultural, domestic, or industrial), recreation (in or on the water), aquatic biota, wildlife habitat, and aesthetics.

criteria - Narrative or numerical statements relating to water quality on which to base a judgement of suitability for beneficial uses.

designated use - A beneficial use listed for a waterbody or waterbodies in a state's water-quality regulations.

discharge - Commonly referred to as "flow"; expressed as volume of fluid per unit time (e.g. cubic feet per second) passing a particular point in a river or channel or from a pipe.

eutrophic - Literally, "nutrient rich"; generally refers to a fertile, productive body of water. Contrasts with **oligotrophic**.

eutrophication - The natural process by which lakes and reservoirs become enriched with dissolved nutrients, resulting in an increased growth of algae and macrophytes and reduced water clarity.

existing use - A beneficial use actually attained by a waterbody on or after November 28, 1975.

integrity - The extent to which all parts or elements of a system (e.g. aquatic ecosystem) are present and functioning.

lentic - Of, or pertaining to, standing waters (*e.g.* ponds, lakes, reservoirs).

littoral zone-	The region along the lake or reservoir shore.
lotic -	Of, or pertaining to, running waters (i.e., streams and rivers).
mesotrophic -	Literally, "of moderate nutrients"; generally refers to a moderately fertile water body.
monitor-	To check or measure water quality (chemical, physical, or biological) for a specific purpose, such as attainment of beneficial uses.
nonpoint source -	A source of pollution originating over a wide geographical area, not discharged from one specific location.
oligotrophic -	Literally, "nutrient poor"; generally refers to an infertile, unproductive body of water. Contrasts with **eutrophic**.
pelagic -	Adjective referring to the open area of a lake or reservoir, from the littoral zone to the center of the lake.
phytoplankton -	Aquatic plants; usually microscopic, sometimes consisting of a single cell.
point source -	A discernable, confined, or discrete conveyance of pollutant, such as a pipe, ditch, or conduit.
pollution -	Any alteration in the character or quality of the environment due to human activity that makes it unfit or less suited for beneficial uses.
reconnaissance -	Exploratory or preliminary
sublittoral -	Adjective referring to the deeper part of the littoral portion of a water body.
water quality -	A term for the combined chemical, physical, and biological characteristics of water that affect its suitability for beneficial uses.

Appendix I. Wadable Streams Proposed for Monitoring in 1997 by Region

Note: Asterisk (*) after stream name indicates an electrofish-only stream, and two asterisks (**) after a stream name indicate a trend stream.

Boise Regional Office

Stream Name	PNRS #	Hydrologic Unit Code
Bruneau River, East Fork	558.00	17050102
Cougar Creek	567.00	17050102
Jacks Creek	551.00	17050102
Sheep Creek	564.00	17050102
Succor Creek	671.00	17050103
Deep Creek**	614.00	17050104
Owyhee River South Fork	632.00	17050105
Squaw Creek	642.00	17050107
Cow Creek	661.01	17050108
Louisa Creek	656.01	17050108
Rock Creek	655.00	17050108
Buck Creek		17050111
Lost Man Creek		17050111
Grouse Creek		17050113
Lime Creek**	588.00	17050113
Rattlesnake Creek		17050113
Wood Creek	576.00	17050113

Stream Name	PNRS #	Hydrologic Unit Code
Blacks Creek	737.00	17050114
Fivemile Creek	734.00	17050114
Indian Creek	732.00	17050114
Indian Creek	731.00	17050114
Mason Creek	733.00	17050114
Sand Hollow Creek	730.00	17050114
Tenmile Creek		17050114
Bulldog Creek		17050121
Big Willow Creek**		17050122
Soldier Creek	697.00	17050122
Beaver Creek	892.00	17050123
Mud Creek**	898.00	17050123
Twentymile Creek**		17050123
Crane Creek	842.00	17050124
Pine Creek	848.00	17050124
Bear Valley Creek	808.10	17060205
Bear Valley Creek	808.00	17060205
Bearskin Creek		17060205
Cache Creek		17060205
Cook Creek		17060205
Cub Creek		17060205
Dagger Creek		17060205
Elkhorn Creek	805.00	17060205
Fir Creek		17060205

Stream Name	PNRS #	Hydrologic Unit Code
Porter Creek		17060205
Sheep Trail Creek		17060205
Dollar Creek		17060208
Johnson Creek	942.00	17060208
Johnson Creek	941.00	17060208
Johnson Creek	940.00	17060208
Salmon River, EF of SF	934.00	17060208
Trout Creek		17060208
Big Creek	877.00	17060210
Salmon River, Little	863.00	17060210
Salmon River, Little	864.00	17060210

Twin Falls Regional Office

Stream Name	PNRS #	Hydrologic Unit Code
Champagne Creek		17040209
Copper Creek		17040209
Cottonwood Creek (Craters)		17040209
Dry Hollow		17040209
East Fork Rock Creek	366	17040209
Fall Creek	364	17040209
Huff Creek		17040209
Land Creek		17040209

Stream Name	PNRS #	Hydrologic Unit Code
Lanes Gulch		17040209
Little Warm Creek		17040209
Marsh Creek		17040209
Rock Creek	365	17040209
South Fork Rock Creek		17040209
Spring Creek		17040209
Warm Creek		17040209
Big Pilgrim Gulch		17040212
Calf Creek		17040212
Cassia Gulch		17040212
Cedar Draw	397	17040212
Clear Creek		17040212
Clover Creek	381	17040212
Cottonwood Creek	403	17040212
Deep Creek	392	17040212
Deep Creek	393	17040212
Deer Creek		17040212
Dempsey Creek		17040212
Donahue Creek		17040212
Dry Creek	408	17040212
Dry Creek	409	17040212
Dry Gulch		17040212
East Fork Clover Creek		17040212
East Fork Dry Creek	410	17040212

Stream Name	PNRS #	Hydrologic Unit Code
Fifth Fork Rock Creek	402	17040212
Fourth Fork Rock Creek		17040212
Harrington Fork		17040212
Little Creek		17040212
McMullen Creek	404	17040212
Middle Fork Dry Creek		17040212
Mud Creek	394	17040212
Rock Creek	400	17040212
Rock Creek	401	17040212
Sand Springs Creek		17040212
Secret Creek		17040212
Swanty Creek		17040212
Third Fork Rock Creek		17040212
Tuana Gulch		17040212
Twin Falls Creek		17040212
West Fork Dry Creek	411	17040212
Aikers Draw		17050102
Big Jacks Creek	554	17050102
Black Leg Creek		17050102
Bruneau River	550	17050102
Bruneau River	549	17050102
Buck Creek		17050102
Buck Flat Draw		17050102

Stream Name	PNRS #	Hydrologic Unit Code
Cat Creek		17050102
Clover Creek	558	17050102
Columbet Creek		17050102
Cottonwood Creek		17050102
Cougar Creek	567	17050102
Deadman Creek		17050102
Deer Creek		17050102
Devil Creek		17050102
Dorsey Creek		17050102
Duncan Creek	556	17050102
East Fork Bull Creek		17050102
Flat Creek		17050102
Hot Creek	557	17050102
Jacks Creek	551	17050102
Jarbidge River	566	17050102
Juniper Draw		17050102
Little Jacks Creek	553	17050102
Louse Creek		17050102
Miller Water		17050102
Poison Creek	568	17050102
Pole Creek		17050102
Pot Hole Creek		17050102
Rattlesnake Creek		17050102
Sailor Creek		17050102

Stream Name	PNRS #	Hydrologic Unit Code
Sheep Creek	563	17050102
Sheep Creek	564	17050102
Sheepshead Draw		17050102
Slaughterhouse Creek		17050102
Spring Creek		17050102
Sugar Creek	552	17050102
Sugar Valley Wash		17050102
Trout Creek		17050102
West Fork Bull Creek		17050102
Wickahoney Creek	555	17050102

Pocatello Regional Office

Stream Name	PNRS #	Hydrologic Unit Code
Bailey Creek		
Bloomington Creek		
Cherry Creek*		
Chippy Creek		
Corral Creek		
Cub River*		
Daves Creek		
Dempsey Creek		
Densmore Creek*		
Devil Creek*		

Stream Name	PNRS #	Hydrologic Unit Code
Diamond Creek		
Eightmile Creek		
Fish Creek		
Fish Haven Creek		
Garden Creek		
Georgetown Creek		
Henderson Creek		
Horse Creek		
Indian Creek		
Lanes Creek		
Little Malad River*		
Lower Rock Creek		
Marsh Creek*		
McTucker Creek*		
Michaud Creek		
Mink Creek		
Muddy Creek		
Olsen Creek		
Ovid Creek*		
Paris Creek		
Pegram Creek		
Pine Creek		
Pocatello Creek*		
Pole Creek		

Stream Name	PNRS #	Hydrologic Unit Code
Portneuf River		
Rapid Creek*		
Samaria Creek		
Sawmill Creek		
Sheep Creek		
Slug Creek		
Smokey Creek		
St. Charles Creek		
Trail Creek*		
Trout Creek*		
Twentyfourmile Creek*		
Two-Mile Creek		
Upper Rock Creek		
Walker Creek		
Weston Creek*		
Wolverine Creek		
Wrights Creek		

Idaho Falls Regional Office

Stream Name	PNRS #	Hydrologic Unit Code
Beaver Creek		17040104
Currant Creek		17040104
Deadman Creek		17040104

Stream Name	PNRS #	Hydrologic Unit Code
Garden Creek		17040104
Haskin Creek		17040104
Muddy Creek		17040104
Pritchard Creek		17040104
Blue Creek		17040202
Fish Creek		17040202
Hope Creek		17040202
Moose Creek		17040202
Partridge Creek		17040202
Porcupine Creek		17040202
Rattlesnake Creek		17040202
Rock Creek		17040202
Sawtel Creek		17040202
Schneider Creek		17040202
Shaefer Creek		17040202
Strong Creek		17040202
Taylor Creek		17040202
Thurman Creek		17040202
Timber Creek		17040202
Toms Creek		17040202
West Dry Creek		17040202
Willow Creek		17040202
Boone Creek		17040203
Conant Creek		17040203

Stream Name	PNRS #	Hydrologic Unit Code
Dry Creek		17040203
Granite Creek		17040203
Squirrel Creek		17040203
Allen Creek		17040204
Bull Elk Creek		17040204
Calamity Creek		17040204
Canyon Creek		17040204
Carlton Creek		17040204
Crooked Creek		17040204
Dry Kiln Creek		17040204
Game Creek		17040204
Grouse Creek		17040204
Lyons Creek		17040204
Middle Twin Creek		17040204
Milk Creek		17040204
Moody Creek		17040204
Pony Creek		17040204
Rammell Hollow Creek		17040204
Sheep Creek		17040204
South Twin Creek		17040204
Spring Creek		17040204
Swanner Creek		17040204
Trail Creek		17040204
Warm Creek		17040204

Stream Name	PNRS #	Hydrologic Unit Code
Wright Creek		17040204
Badger Creek		17040205
Blacktail Creek		17040205
Bridge Creek		17040205
Bulls Fork Creek		17040205
Canyon Creek		17040205
Cattle Creek		17040205
Clark Creek		17040205
Crooked Creek		17040205
Deep Creek		17040205
Deer Creek		17040205
Eagle Creek		17040205
Indian Fork Creek		17040205
Jones Creek		17040205
Meadow Creek		17040205
Mud Creek		17040205
Noon Creek		17040205
Peterson Creek		17040205
Pipe Creek		17040205
Poison Creek		17040205
Rock Creek		17040205
Shirley Creek		17040205
Twin Creek		17040205
Willow Creek		17040205

Stream Name	PNRS #	Hydrologic Unit Code
Camas Creek		17040214
Corral Creek		17040214
Cottonwood Creek		17040214
Cow Creek		17040214
Crab Creek		17040214
Dairy Creek		17040214
Little Warm Creek		17040214
Long Creek		17040214
Modoc Creek		17040214
Rattlesnake Creek		17040214
Spring Creek		17040214
Telephone Creek		17040214
Threemile Creek		17040214
Chandler Canyon Creek		17040215
Crooked Creek		17040215
Divide Creek		17040215
Horse Creek		17040215
Indian Creek		17040215
McNeary Creek		17040215
Middle Creek		17040215
Myers Creek		17040215
Rocky Creek		17040215
Webber Creek		17040215

Stream Name	PNRS #	Hydrologic Unit Code
Coal Kiln Canyon Creek		17040216
Cottonwood Creek		17040216
Mud Creek		17040216
Pass Creek		17040216
Sawmill Canyon Creek		17040216
Willow Creek		17040216
Aspen Creek		17040217
Barney Creek		17040217
Basin Creek		17040217
Bell Mountain Creek		17040217
Big Creek		17040217
Black Creek		17040217
Boulder Creek		17040217
Bull Creek		17040217
Chicken Creek		17040217
Corral Creek		17040217
Deep Creek		17040217
Long Lost Creek		17040217
Mahogany Creek		17040217
Meadow Creek		17040217
Red Rock Creek		17040217
South Creek		17040217
Timber Creek		17040217

Stream Name	PNRS #	Hydrologic Unit Code
Alder Creek		17040218
Bartlett Creek		17040218
Boone Creek		17040218
Burnt Creek		17040218
Castle Creek		17040218
Cedar Creek		17040218
Grasshopper Creek		17040218
Jones Creek		17040218
Little Burns Creek		17040218
Lone Pine Creek		17040218
Navarre Creek		17040218
Pinto Creek		17040218
Rock Creek		17040218
Sage Creek		17040218
Thousand Springs Creek		17040218
Willow Creek		17040218
Alturas Creek		17060201
Big Lake Creek		17060201
Boulder Creek		17060201
Corral Creek		17060201
Eightmile Creek		17060201
Elevenmile Creek		17060201
Elk Creek		17060201

Stream Name	PNRS #	Hydrologic Unit Code
Fishhook Creek		17060201
Germania Creek		17060201
Hell Roaring Creek		17060201
Herd Creek		17060201
Horse Basin Creek		17060201
Iron Creek		17060201
Kelly Creek		17060201
Mill Creek		17060201
Ninemile Creek		17060201
Redfish Lake Creek		17060201
Sevenmile Creek		17060201
Spar Canyon Creek		17060201
Slate Creek		17060201
Twelvemile Creek		17060201
West Pass Creek		17060201
Burnt Creek		17060202
Donkey Creek		17060202
Double Spring Creek		17060202
Falls Creek		17060202
Grouse Creek		17060202
Long Creek		17060202
Meadow Creek		17060202
Morgan Creek		17060202
Anderson Creek		17060203

Stream Name	PNRS #	Hydrologic Unit Code
Beaver Creek		17060203
Copper Creek		17060203
Dahlonega Creek		17060203
Deep Creek		17060203
Hughes Creek		17060203
Indian Creek		17060203
Moose Creek		17060203
Moyer Creek		17060203
Pierce Creek		17060203
Porphyry Creek		17060203
Sheep Creek		17060203
Wagonhammer Creek		17060203
Woodtick Creek		17060203
Baldy Creek		17060204
Basin Creek		17060204
Bear Valley Creek		17060204
Clear Creek		17060204
Deer Creek		17060204
Divide Creek		17060204
East Fork Hayden Creek		17060204
Ferry Creek		17060204
Hayden Creek		17060204
Haynes Creek		17060204

Stream Name	PNRS #	Hydrologic Unit Code
Lee Creek		17060204
Little Timber Creek		17060204
Middle Fork Little Timber Creek		17060204
Muddy Creek		17060204
Pattee Creek		17060204
Peterson Creek		17060204
Pratt Creek		17060204
Reese Creek		17060204
Spring Creek		17060204
Stroud Creek		17060204
Tenmile Creek		17060204
Texas Creek		17060204
Walter Creek		17060204
Withington Creek		17060204
Yearian Creek		17060204

Lewiston and Grangeville Regional Offices

Stream Name	PNRS #	Hydrologic Unit Code
Corral Creek		17060101
Divide Creek		17060101
Getta Creek		17060101
Wolf Creek		17060101

Stream Name	PNRS #	Hydrologic Unit Code
Big Creek		17060207
Big Mallard Creek		17060207
Crooked Creek		17060207
Jersey Creek		17060207
Little Mallard Creek		17060207
Rhett Creek		17060207
Warren Creek		17060207
Allison Creek		17060209
China Creek (Nez Perce County)		17060209
China Creek (near Lucile)		17060209
Cottonwood Creek		17060209
Cow Creek		17060209
Deep Creek		17060209
Deep Creek (Lewis County)		17060209
Deer Creek (Idaho County)		17060209
Deer Creek (Nez Perce/Lewis)		17060209
Grave Creek		17060209
Jungle Creek		17060209
Kessler Creek		17060209
Little Slate Creek		17060209
Little Whitebird Creek		17060209

Stream Name	PNRS #	Hydrologic Unit Code
Maloney Creek		17060209
Pinnacle Creek		17060209
Race Creek		17060209
Rice Creek		17060209
Rock Creek		17060209
Skookumchuck Creek		17060209
Slate Creek		17060209
Turnbull Creek		17060209
Van Buren Creek		17060209
China Creek		17060307
Cold Springs Creek		17060307
Cool Creek		17060307
Cougar Creek		17060307
Deception Creek		17060307
Gravey Creek		17060307
Grizzley Creek		17060307
Hem Creek		17060307
Laundry Creek		17060307
Marten Creek		17060307
Middle Creek		17060307
Orogrande Creek		17060307
Osier Creek		17060307
Sneak Creek		17060307
Sugar Creek		17060307

Stream Name	PNRS #	Hydrologic Unit Code
Swamp Creek		17060307
Sylvan Creek		17060307
Tamarack Creek		17060307
Tumble Creek		17060307
Beaver Creek		17060308
SF Beaver Creek		17060308
Bertha Creek		17060308
Bingo Creek		17060308
Breakfast Creek		17060308
Cranberry Creek		17060308
Dog Creek		17060308
Elk Creek		17060308
WF Elk Creek		17060308
Floodwood Creek		17060308
Isabella Creek		17060308
Johnson Creek		17060308
Long Meadow Creek		17060308
Partridge Creek		17060308
Reeds Creek		17060308
Sourdough Creek		17060308
Stony Creek		17060308
Swamp Creek		17060308
Big Creek		
Elk Creek		

Stream Name	PNRS #	Hydrologic Unit Code
Indian Creek		
Little Salmon River		
Shingle Creek		
Squaw Creek		

Coeur d'Alene Regional Office

Stream Name	PNRS #	Hydrologic Unit Code
Alpine Creek		
Buckskin Creek		
Burton Creek		
Carpenter Creek		
Chloride Gulch		
Colburn Creek		
Cougar Creek		
Cow Creek		
EF Big Creek		
EF Pine Creek		
Flume Creek		
Hamman Creek		
Hangman Creek		
Hoodoo Creek		
Independence Creek		
Kalispell Creek		

Stream Name	PNRS #	Hydrologic Unit Code
Kidd Creek		
Kriest Creek		
Lamb Creek		
Larch Creek		
Little Sand Creek		
Lower West Branch Priest River		
NF St. Joe River		
North Branch North Gold Creek		
North Gold Creek		
Nugget Creek		
Prichard Creek		
Prospect Creek		
Rapid Lightning Creek		
Round Prairie Creek		
Ruby Creek		
Sand Creek		
Schweitzer Creek		
Siawash Creek		
Skookum Creek		
Spruce Creek		
Wellington Creek		
Boundary Creek*		17010104
Snow Creek*		17010104

Stream Name	PNRS #	Hydrologic Unit Code
Spring Creek*		17010213
Brickel Creek*		17010214
Cocolalla Creek*		17010214
Fish Creek*		17010214
Big Creek*		17010215
East River		17010215
Granite Creek*		17010215
MF East River		17010215
Two Mouth Creek*		17010215
Bumblebee Creek*		17010301
Burnt Cabin Creek*		17010301
Cinnamon Creek*		17010301
Cougar Creek*		17010301
Cub Creek*		17010301
Downey Creek*		17010301
Falls Creek*		17010301
Laverne Creek*		17010301
Little NF Coeur d'Alene River		17010301
Lost Fork Creek*		17010301
Trail Creek*		17010301
EF Pine Creek*		17010302
Moon Creek*		17010302
Fernan Creek*		17010303

Stream Name	PNRS #	Hydrologic Unit Code
Fourth of July Creek*		17010303
North Fork Mica Creek*		17010303
Rockford Creek*		17010303
South Fork Mica Creek*		17010303
Wolf Lodge Creek*		17010303
Bear Creek*		17010304
Big Creek*		17010304
Carpenter Creek*		17010304
Emerald Creek*		17010304
Fishhook Creek*		17010304
Gold Creek*		17010304
John Creek*		17010304
Little Bear Creek*		17010304
Marble Creek*		17010304
Merry Creek*		17010304
Mica Creek*		17010304
Mosquito Creek*		17010304
Sisters Creek*		17010304
Toles Creek*		17010304
Fish Creek*		17010305
Hangman Creek*		17010306

Appendix II. Large Rivers Proposed for Monitoring in 1997

Boise Regional Office

Water Body	PNRS #	Hydrologic Unit Code
Boise River	728	17050114
Snake River	664	17050115
Boise River	726	17050121
Boise River	727	17050121
Payette River		17050122

Twin Falls Regional Office

Water Body	PNRS #	Hydrologic Unit Code
Snake River	362	17040206
Snake River	369	17040212
Snake River		17040212
Big Wood River	476	17040219
Bruneau River	549	17050102
Little Wood River	511	

Pocatello Regional Office

Water Body	PNRS #	Hydrologic Unit Code
Blackfoot River	302.1	17040207

Water Body	PNRS #	Hydrologic Unit Code
Blackfoot River	303	17040207
Blackfoot River	305	17040207
Portneuf River	324.1	17040208
Portneuf River	324.2	17040208
Portneuf River	326	17040208
Portneuf River	327	17040208
Portneuf River	325	

Idaho Falls Regional Office

Water Body	PNRS #	Hydrologic Unit Code
Snake River, SF	3	17040104
Snake River, SF	4	17040104
Henrys Fork	60	17040202
Henrys Fork	81	17040202

Lewiston Regional Office

Water Body	PNRS #	Hydrologic Unit Code
Lochsa		17060303
Clearwater, SF		17060305

Coeur d'Alene Regional Office

Water Body	PNRS #	Hydrologic Unit Code
Moyie River	1395	17010105
Pack River	1449	17010214
Pend Oreille River	1436	17010214
Priest River	1407	17010215
Priest River		17010215
Coeur d'Alene River, NF	1481	17010301
St. Maries River	1579	17010304

Appendix III. Lakes and Reservoirs Proposed for Monitoring in 1997

Water Body	PNRS #	Hydrologic Unit Code
Cocalalla Lake	1442.1	17010214
Hayden Lake	1555.1	17010305
Henry's Lake	106	17040202
American Falls Reservoir	346	17040206
Hawkins Reservoir	337.1	17040208
Sublett Reservoir	434	17040210
Little Lower Goose Reservoir (Oakley Reservoir)	446	17040211
Pioneer Reservoir	380	17040212
Mormon Reservoir	539	17040220
Blue Creek Reservoir	627	17050104
Juniper Basin Reservoir	625	17050104
Crane Creek Reservoir	841	17050124
Elk Creek Reservoir	1190	17060308
Black Lake	1529.5	
Brundage Reservoir		
Fernan Lake	1543.1	
Island Park Reservoir		
Ririe Reservoir	36	

Appendix IV. Beneficial Use Reconnaissance Field Form (Wadable Streams)

1997 Beneficial Use Reconnaissance Project Field Forms
Idaho Division of Environmental Quality

Site Identification

Stream Name: ____________ Site ID: 97 ____________ Date (YY/MM/DD): 97 ________

HUC: ____________ PNRS: ____________ WB ID No.: ____________

Public Land Survey: Twnshp ________ Range ________ Section ________ ________ 1/4 of the ________ 1/4 of the ________ 1/4

Latitude: ________ Degrees ________ Minutes ________ . ________ Seconds Longitude: ________ Degrees ________ Minutes ________ . ________ Seconds

Datum: NAD83 ________ NAD27 ________ Other ________ Lat/Long Confidence: 2-5 meters ________ 100 meters (raw) ________ 500 meters (estimate) ________

County: ____________ Ecoregion: ____________ Map Elevation (ft or m) ____________

Location Relative to Landmark: ____________

Weather Conditions: ____________ Crew Members: ____________

Data Collection

General Wetted Width: ________ meters Total Reach Length: ________ (20 X wetted width or100 m minimum)

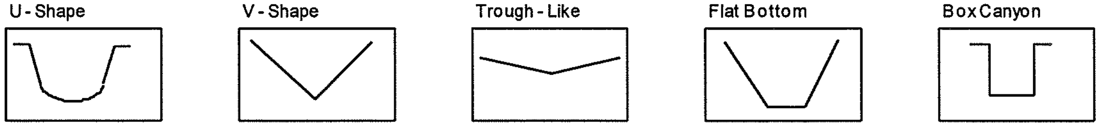
Stream Order: 1 2 3 4 5 (circle one) Stream Gradient: ________ % Rosgen Stream Type: ________

Temperature: ________ Time: ________ Amphibians Observed: ____________

Fish Observed: ____________

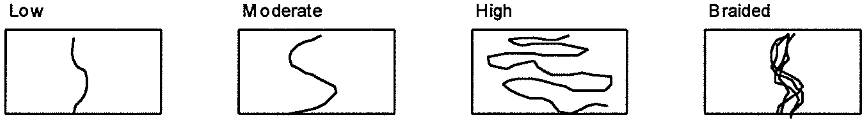
Valley Type:
circle one

U - Shape V - Shape Trough - Like Flat Bottom Box Canyon



Low Moderate High Braided

Sinuosity:
circle one



Activities Affecting Reach

Circle All That Apply:

Forestry Mining
Agriculture Roads
Recreation Urban
Diversion Grazing
Wilderness
Beaver Complex
Other: ________
____

*describe all in notes

Additional Information (include riparian composition and status):

1997 Beneficial Use Reconnaissance Project Field Forms

Stream Name: ______ Site ID: 97 ______ Date (YY/MM/DD): 97 ______

Additional Information (continued):

1997 Beneficial Use Reconnaissance Project Field Forms

Stream Name: ______________________ Site ID: 97 ________ Date (YY/MM/DD): 97 ________

Discharge Measurement

	Tape	Width	Depth	Area	Velocity	Velocity	Dischrge
	ft	ft	ft	sq ft	ft/sec	ft/sec	cfs
LWE							
1							
2							
3							
4							
5							
6							
7							
8							
9							
10							
11							
12							
13							
14							
15							
16							
17							
18							
19							
20							
RWE							

Total Flow ________

MacroInvertebrate Samples

Were samples taken during low/stable flow period
(July 1 through October 15)? Yes No

Sample No. 1
Label: ______________________
Sampler Used: Hess Surber Kick
Habitat Sampled: Riffle Run Glide Pool
Time: ________
By: ________

Sample No. 2
Label: ______________________
Sampler Used: Hess Surber Kick
Habitat Sampled: Riffle Run Glide Pool
Time: ________
By: ________

Sample No. 3
Label: ______________________
Sampler Used: Hess Surber Kick
Habitat Sampled: Riffle Run Glide Pool
Time: ________
By: ________

1997 Beneficial Use Reconnaissance Project Field Forms

Stream Name: ____________ Site ID: 97 ____________ Date (YY/MM/DD): 97 ____________

Wolman Pebble Count (Modified)

Particle Size	Riffle 1		Riffle 2		Riffle 3	
	Within Wetted	Outside Wetted	Within Wetted	Outside Wetted	Within Wetted	Outside Wetted
silt/clay 0-1mm						
sand 1.1-2.5 mm						
very fine pebble 2.51-6 mm						
Subtotal						
pebble 6.1-15 mm						
coarse pebble 15.1-31mm						
very coarse pebble 31.1-64 mm						
small cobble 64.1-128 mm						
large cobble 128.1-256 mm						
small boulder 256.1-512 mm						
medium boulder 512.1-1024 mm						
large boulder 1024.1mm &larger						
Total						

Large Organic Debris

Total number of pieces larger than 10cm diameter and 1m length:

*Within Bankfull

Canopy Closure

	Riffle 1	Riffle 2	Riffle 3
Left Bank*			
Center Up			
Center Down			
Right Bank*			

*Facing Upstream

1997 Beneficial Use Reconnaissance Project Field Forms

Stream Name: ______________________ Site ID: 97 ______________ Date (YY/MM/DD): 97 ________

Width/Depth Ratio

	Bankfull Width(m)	Wetted Width(m)	Depth To Wetted Edge(m)	Avg Wetted Depth(m)
Transect 1				
Transect 2				
Transect 3				

Wetted Depth Measurements (m)**

Transect 1							
Transect 2							
Transect 3							

** Wetted Width	# Measurements
< 1m	3
1m to 4 m	5
>4 m	7

Photo Information

Roll Name (Number): ______________________

Photo #: ______ Azimuth ______ Direction (circle one): Upstream Downstream Panorama

Photo #. ______ Azimuth ______ Direction (circle one): Upstream Downstream Panorama

Photo #: ______ Azimuth ______ Direction (circle one): Upstream Downstream Panorama

Comments:

Other:

Photo #. ______ Caption: ______________________

Photo #. ______ Caption: ______________________

Photo #. ______ Caption: ______________________

1997 Beneficial Use Reconnaissance Project Field Forms

Stream Name: ______________________ Site ID: 97 ______ Date (YY/MM/DD): 97 ______

Longitudinal Habitat Distribution (meters)

Riffle	Run	Glide	Pool
Total	Total	Total	Total

Streambank Condition (percent)

Left Bank Facing Upstream				Right Bank Facing Upstream			
Covered Stable	Covered Unstable	Uncvred Stable	Uncvred Unstable	Covered Stable	Covered Unstable	Uncvred Stable	Uncvred Unstable

Habitat Assessment Summary Sheet

Prevalence (circle one)			
Riffle/Run		Glide/Pool	
1. Bottom Substrate - %fines			1. Pool Substrate Char.
2. Instream Cover			2. Instream Cover (fish)
3. Embeddedness (riffles)			3. Pool Variability
4. Velocity/Depth			4. Canopy Cover
5. Channel Shape			5. Channel Shape
6. Pool/Riffle Ratio			6. Channel Sinuosity
7. Width/Depth Ratio (wetted)			7. Width/Depth Ratio
8. Bank Vegetation Protection			8. Bank Vegetation Protection
9. Bank Stability			9. Bank Stability
10. Disruptive Pressures			10. Disruptive Pressures
11. Zone of Influence			11. Zone of Influence
Total Score			

Pool Quality Index

Pool Quality Parameter		Pool Number 1	2	3	4	Code Explanation
Max Pool Depth (m)						
Tail Out Depth (m)						
Pool Length (m)						
Max Pool Width (m)						
Residual Depth	(m)					<0.15m = 0 0.15m to 0.45m = 1
	code					>0.45m = 2
Avg Substrate Size	(mm)					<63.5mm = 0 63.5 to 254mm = 1
	code					>254mm = 2
Overhead Cover	(%)					<10% = 0 10% to 25% = 1
	code					>25% = 2
Undercut Banks	(%)					<25% = 0 25% to 50% = 1
	code					>50% = 2
Submerged Cover	(%)					<10% = 0 10% to 25% = 1
	code					>25% = 2
Total Score						
					Ave Score	

Appendix V. Beneficial Use Reconnaissance Project Field Form (Large Rivers)

1997 Beneficial Use Reconnaissance Project Field Forms: Large River Form
Idaho Division of Environmental Quality

Site Identification

Stream Name: ______ Site ID: 97 ______ Date (YY/MM/DD): 97 ______

Segment Description: From: ______ To: ______

HUC: ______ PNRS: ______ WB ID No.: ______

Public Land Survey: Twnshp ______ Range ______ Section ______ 1/4 of the ______ 1/4 of the ______ 1/4

Latitude: ______ Degrees ______ Minutes ______ . Seconds Longitude: ______ Degrees ______ Minutes ______ . Seconds

Datum: NAD83 ______ NAD27 ______ Other ______ Lat/Long Confidence: 2-5 meters ______ 100 meters (raw) ______ 500 meters (estimate) ______

County: ______ Ecoregion: ______ Map Elevation (ft or m) ______

Location Relative to Landmark: ______

Weather Conditions: ______ Crew Members: ______

Data Collection

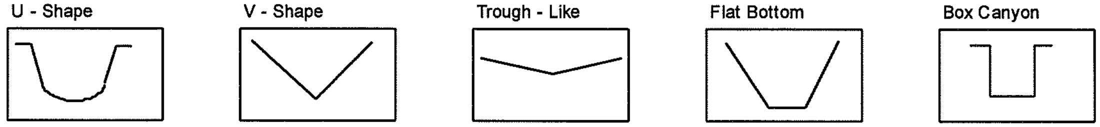
Total Length of Reach Surveyed: ______ m

Stream Order: 5 6 7 8 9 (circle one) Stream Gradient: ______ %

Fish Observed: ______ Amphibians Observed: ______

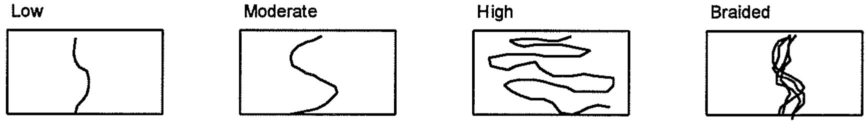
Valley Type: circle one

U - Shape V - Shape Trough - Like Flat Bottom Box Canyon



Low Moderate High Braided

Sinuosity: circle one



Predominant Activities Affecting Watershed

Above Reach

Circle All That Apply:

Forestry Mining

Agriculture Roads

Recreation Urban

Diversion Grazing

Wilderness

Beaver Complex

Other: ______

______

*describe all in notes

Additional Information (include riparian composition and status):

1997 Beneficial Use Reconnaissance Project Field Forms: Large River Form

Stream Name: ______________________ Site ID: 97__________ Date (YY/MM/DD): 97______

Additional Information (continued):

Include All Of The Following:

1. Water Clarity (circle one) Very Turbid Turbid Slightly Turbid Clear
2. Discharge (if known) - USGS or Measured (see pg. 7) [ ]
3. Percent Of Natural Floodplain Available [ ]
4. Riparian Vegetation

Predominant Vegetation

_____ dense stands of trees and/or shrubs

_____ open stands of trees and/or shrubs

_____ meadow-like, grasses, rushes, cattails, sedges, etc.

_____ rangeland-like, dryland shrubs or weedy

Extensiveness

_____ intact without breaks

_____ breaks occurring intermittently

_____ breaks frequent - some gullies and scars every 100 to 150 ft

_____ severely degraded or deeply scarred with active headcutting or gully formation

Condition

_____ thick, mature, dense stands with no signs of disturbance

_____ open stands with light to medium disturbance

_____ severely degraded and impacted - bare spots

Principle source of dusturbance ______________________

Community species in descending order of dominance

______________ ______________

______________ ______________

______________ ______________

______________ ______________

______________ ______________

Detailed Drawing of Entire Reach

1997 Beneficial Use Reconnaissance Project Field Forms

Stream Name: ____________________ Site ID: 97 ____________ Date (YY/MM/DD): 97 ________

	Transect 1		Transect 2		Transect 3		Transect 4		Transect 5		Transect 6	
	Left Bank*	Right Bank*	Left Bank*	Right Bank*	Left Bank*	Right Bank*	Left Bank*	Right Bank*	Left Bank*	Right Bank*	Left Bank*	Right Bank*
Wetted Width(m)												
Bankfull Width(m)												
Bankfull Height(m)**												
Bank Stability(code)***												
Bank Material(code)****												

Longitudinal Habitat Distribution

	Length	%
Riffle		
Run		
Glide		
Pool		

* facing upstream

** water surface to bankfull

*** within 2m of either side of transect (see page 7)

**** dominant substrate within 2m of either side of transect - water surface to bankfull (see page 7)

Transect No. Wetted Depth(m)**

1																			
3																			
6																			

Substrate Size(code)***

1																			
3																			
6																			

Macrophyte****

1																			
3																			
6																			

** minimum 10 measurements

*** at same location as depth measurements (see page 7)

**** note presence/absence by yes (Y) or no (N)

1997 Beneficial Use Reconnaissance Project Field Forms

Stream Name: Site ID: 97 Date (YY/MM/DD): 97

MacroInvertebrate Sample

Transect 1

Label:

Sampler Used: Slack Sampler Petite Ponar

Habitat Sampled: Riffle Run Glide Pool

Time:

By:

Embeddedness (%)

0 to 25	25 - 50	50-75	>75

Transect 3

Label:

Sampler Used: Slack Sampler Petite Ponar

Habitat Sampled: Riffle Run Glide Pool

Time:

By:

Embeddedness (%)

0 to 25	25 - 50	50-75	>75

Transect 6

Label:

Sampler Used: Slack Sampler Petite Ponar

Habitat Sampled: Riffle Run Glide Pool

Time:

By:

Embeddedness (%)

0 to 25	25 - 50	50-75	>75

Phytoplankton Collection

Label:

Sample Location:

Time Collected:

By:

Time Filtered:

By:

Volume Filtered:

Periphyton Collection

Transect 1

Abundance: Dense Moderate Sparse None

Number Samples Collected and Composited:

Sampler Used: Sample Area:

Habitat Sampled: Riffle Run Glide Pool

Transect 3

Abundance: Dense Moderate Sparse None

Number Samples Collected and Composited:

Sampler Used: Sampler Area:

Habitat Sampled: Riffle Run Glide Pool

Transect 6

Abundance: Dense Moderate Sparse None

Number Samples Collected and Composited:

Sampler Used: Sampler Area:

Habitat Sampled: Riffle Run Glide Pool

1997 Beneficial Use Reconnaissance Project Field Forms

Stream Name: ______________________ Site ID: 97 __________ Date (YY/MM/DD): 97 ______

Channel Alteration/Bank Modification (describe in detail)

Transect 1	Transect 2
Codes:	Codes:

Transect 3	Transect 4
Codes:	Codes:

Transect 5	Transect 6
Codes:	Codes:

BR - Bridge	HP - Hydropower	NL - Natural lake	TD - Thermal discharge
CA - Channelized Area	IM - Impoundment	SS - Storm sewer	WT - Wastewater treatment
DV - Diversion	IO - Industrial Outflow	SB - Streambank stabilization	OT - Other
FL - Feedlot	LH - Low head dam		

1997 Beneficial Use Reconnaissance Project Field Forms

Stream Name: ____________________ Site ID: 97 ____________ Date (YY/MM/DD): 97 ________

Hydrolab Calibration

Date Of Calibration: ____________

Dissolved Oxygen Calibration w / Barrometric Pressure Of: ____________

pH Calibration w / Standard Of: ____________

pH Calibration w / Standard Of: ____________

ReDox Calibration w / Standard Of: ____________

Conductivity Calibration w / Standard Of:

Hydrolab Readings

Temperature: ____________ Time: ________

Dissolved Oxygen: ____________

Conductivity: ____________

pH: ____________

Total Dissolved Solids: ____________

ReDox: ____________

Percent Saturation:

Additional Comments:

Photo Information

Roll Name (Number):

Photo #	Azimuth	Caption

Fecal Coliform Bacteria

Label: ____________

Location Taken: ____________

Time Taken: ____________

Taken By: ____________

Current Activities Immediately Above Reach Which Might Affect Results:

1997 Beneficial Use Reconnaissance Project Field Forms

Stream Name: ____________________ Site ID: 97 __________ Date (YY/MM/DD): 97 ______

Discharge Measurement (if needed)

	Tape	Width	Depth	Area	Velocity	Velocity	Discharge
	ft	ft	ft	sq ft	ft/sec	ft/sec	cfs
LWE							
1							
2							
3							
4							
5							
6							
7							
8							
9							
10							
11							
12							
13							
14							
15							
16							
17							
18							
19							
20							
21							
22							
23							
RWE							

Total Discharge

Codes:

Bank Stability:
- DA - Debris Avalanche
- RF - Rotational Failure
- SL - Slab Failure
- CB - Cutbank Scalloping
- NO - None

Bank Material and Substrate Size:
- SI - Silt
- SA - Sand
- MU - Muck
- GV - Gravel
- CO - Cobble
- BO - Boulder
- BR - Bedrock
- HP - Hardpan
- MA - Marl
- DE - Detritus
- AR - Artificial

Appendix VI. Beneficial Use Reconnaissance Field Form (Lakes and Reservoirs)

This field form has not yet been completed. For more information, contact Brian Hoelscher at (208) 373-0502.

Appendix VII. Field Equipment Checklists

Wadable Streams

EQUIPMENT DESCRIPTION	YES	NO
MACROINVERTEBRATE SAMPLE EQUIPMENT:		
Hess and Surber samplers (500-μ mesh w/300 ml bucket)		
White pans		
Kick nets		
Macro sample containers		
Preservative (70% ethanol)		
Spare nets for Samplers		
Scrub brush		
Wash (squirt) bottles for rinsing (water and alcohol)		
Field labels		
Field data forms		
Rubber gloves		
Forceps		
Pencils/Indelible alcohol proof markers		
ELECTROFISHING EQUIPMENT:		
Electrofisher		
Anode and cathode		
Dip nets		
Waders		
Rubber gloves (shoulder length)		

EQUIPMENT DESCRIPTION	YES	NO
Specific Conductivity Meter		
Preservative: 10% buffered formalin solution		
Scales (weight (springs) & length)		
Thermometer		
Collecting permit or IDFG personnel		
Anesthetic		
Buckets		
Gas/oil		
Generator (if using a battery powered electrofisher) + spare parts		
Specimen vouchering containers		
Fish measuring board		
Fish identification keys		
Clipboard/notebook/fish labels		
Field data sheets		
First-aid kit		
Polarized sunglasses		
Fire extinguisher		
CPR Certification		
WOLMAN PEBBLE COUNT EQUIPMENT:		
Metric ruler (clear plastic) or angled measuring device listed in Protocol #2		
Shoulder-length gloves		
Pencils/pens		
Field data sheets		

EQUIPMENT DESCRIPTION	YES	NO
FLOW MEASUREMENT EQUIPMENT:		
Current velocity meter		
Top-setting-wading rod		
100-ft. measuring tape (minimum length)		
Rebar stakes		
Flow sheets		
Pencils/clipboard		
Waders		
Extra batteries for current meter		
MISCELLANEOUS EQUIPMENT:		
Densiometer		
2-meter rod		
Polarized sunglasses		
Tape measures		
Random number table		
Field notebook/clipboards		
Maps		
All forms and labels		
Sunscreen		
Camera & film		
Extra batteries		
Emergency equipment for vehicle		
First aid kit		
GPS receiver		
Current Beneficial Use Reconnaissance Project Workplan		

EQUIPMENT DESCRIPTION	YES	NO
DEQ/Other Protocols		
Tool Kit		
Pens/pencils		

Large Rivers

EQUIPMENT DESCRIPTION	YES	NO
PHOTODOCUMENTATION EQUIPMENT:		
Camera		
Film		
Dry-erase board w/ cover cloths		
Compass		
DISCHARGE EQUIPMENT:		
Flow meter (if not using USGS data)		
WIDTH/DEPTH EQUIPMENT		
200-m tape measure		
Rangefinder		
Extendable surveyor's rod or 2-meter rod		
FLOODPLAIN DISTURBANCE EQUIPMENT:		
Aerial photos		
Stereoscope		
GIS coverage		
Substrate probe		

EQUIPMENT DESCRIPTION	YES	NO
SUBSTRATE SIZE EQUIPMENT:		
View boxes		
WATER TEMP, pH, OXYGEN, ET AL EQUIPMENT:		
Hydrolab©		
FECAL COLIFORM COUNT EQUIPMENT:		
Sample containers		
Ice chest		
Ice		
MACROINVERTEBRATE SAMPLE EQUIPMENT:		
Slack sampler		
Petite Ponar		
White pans		
Sample Containers		
Preservative (70% ethanol)		
Spare nets for Slack samplers		
Scrub brush		
Wash (squirt) bottles for rinsing (water and alcohol)		
Field labels		
Rubber gloves/trapper gloves		
Forceps		
Indelible, alcohol-proof markers		
Waders		
Spikes (digging)		
PERIPHYTON EQUIPMENT:		
SG-92 samplers (O-rings and 30-mL syringe)		

EQUIPMENT DESCRIPTION	YES	NO
Periphyton brushes (stiff-bristled toothbrushes, 0.64-cm diameter plastic rods)		
Plastic tub		
Sample containers		
Sample cooler and ice		
PHYTOPLANKTON (CHLOROPHYLL A) EQUIPMENT:		
Filtration assembly		
Filters, glass-fiber, 47-mm diameter disks, 0.7-µ pore size		
Graduated cylinders: 50-mL, 100-mL, and 250-mL, plastic		
Vials, scintillation, 20-mL capacity		
Sample cooler and ice		
Aluminum foil		
MISCELLANEOUS EQUIPMENT:		
Vehicles with cabs and towing capacity		
Boat		
GPS receiver		
Life jackets		
First-aid kit		
Tool kit		
Extra batteries		
Field notebook/clipboards		
Blank field forms		

Lakes and Reservoirs

EQUIPMENT DESCRIPTION	YES	NO
GENERAL EQUIPMENT:		
Boat		
Fire extinguisher		
Life vests (3)		
Gas/oil		
Boat paddle		
Anchor		
Bucket		
Aluminum form holder		
Field forms		
BATHYMETRY/DEPTH EQUIPMENT:		
Global Positioning System		
Compass		
Fathometer		
Stop watch		
WATER CLARITY EQUIPMENT:		
Secchi disk		
TEMP, DISSOLVED OXYGEN, pH, CONDUCTIVITY EQUIPMENT:		
Hydrolab©		
Laptop computer		
NUTRIENTS EQUIPMENT:		
2.2-L Van Dorn bottle		

EQUIPMENT DESCRIPTION	YES	NO
14-L churnsplitter		
1-L cubitainers (19)		
2-ml ampules concentrated H_2SO_4 (12)		
Hand-operated vacuum pump filter apparatus		
0.45-μ cellulose nitrate filters (12)		
Filter forceps		
Indelible marker		
Cooler		
Ice		
CHLOROPHYLL *a* EQUIPMENT		
2.2-L Van Dorn bottle		
14-L churnsplitter		
Hand-operated vacuum pump filter apparatus		
0.7-μ glass fiber filters (3)		
Filter forceps		
Magnesium carbonate		
Petri dishes (3)		
Aluminum foil		
Indelible marker		
Cooler		
Ice		
PHYTOPLANKTON EQUIPMENT		
2.2-L Van Dorn bottle		
14-L churnsplitter		

EQUIPMENT DESCRIPTION	YES	NO
250-ml brown polyethylene bottles (3)		
Lugol's iodine solution		
Indelible marker		
Cooler		
Ice		
SHORELINE PHYS. HABITAT EQUIPMENT:		
Rangefinder		
PERIPHYTON EQUIPMENT:		
Rangefinder		
Viewbox		
AQUATIC MACROPHYTE EQUIPMENT:		
Rangefinder		
Viewbox		
Rake		
Plastic Ziploc bags		
Indelible marker		
Cooler		
Ice		
LITTORAL BOTTOM SUBSTRATE EQUIPMENT:		
Rangefinder		
Viewbox		
Substrate probe		
PHOTO AND DIAGRAMMATIC MAPPING EQUIPMENT:		
Camera		

EQUIPMENT DESCRIPTION	YES	NO
Film		
Dry-erase board		
Viewbox		
MACROINVERTEBRATE EQUIPMENT:		
Petite Ponar dredge		
500-µ sieve bucket		
Sample containers (2)		
Squirt bottles (water and alcohol)		
Preservative (70% ethanol)		
Rubber gloves		
Forceps		
Field labels		
Indelible, alcohol-proof marker		

Appendix VIII. Electrofishing Safety Plan

Purpose

The purpose is to ensure human safety during electrofishing operations by establishing DEQ competency requirements for electrofishing operations. This plan also provides guidelines for a standard operating procedure and the safe operation of electrofishing equipment.

Scope

The provisions of this plan apply to all DEQ activities using electricity (produced by gasoline-powered generator/alternators or batteries) to sample animals in aquatic habitats.

Policy

The Division of Environmental Quality recognizes the electrofishing operation as a hazardous activity for which skills and training are required. It is, therefore, DEQ policy that all personnel serving as BURP coordinators demonstrate knowledge of the principles and techniques of electrofishing. The Beneficial Use Reconnaissance Project coordinators will be considered knowledgeable of the principles and techniques of electrofishing upon satisfactory completion of the US Fish and Wildlife Service Principles and Techniques of Electrofishing course or equivalent training.

Responsibilities

- The Division of Environmental Quality Health and Safety Coordinator is responsible for maintaining a current listing of all DEQ personnel who have attended electrofishing training.

- The Division of Environmental Quality regional administrators are responsible for ensuring compliance with the provisions of this plan.

- BURP coordinators are responsible for:
  1. providing electrofishing crews with the proper equipment and ensuring that such equipment is fully functional at the beginning of the field season;
  2. ensuring that the electrofishing crew have and utilize the proper safety equipment;
  3. ensuring that all crew members are first-aid and CPR-certified;
  4. ensuring the availability of a well-equipped, water-tight first-aid kit;
  5. discussing potential hazardous conditions encountered during electrofishing operations with crew members;

6. ensuring that all crew members are trained in proper electrofishing techniques; and
7. designating an electrofishing team leader.

- Only individuals demonstrating knowledge of electrofishing techniques can serve as electrofishing team leaders. As the individuals in charge of electrofishing operations, the team leaders are responsible for:

1. identifying hazardous field conditions associated with proposed electrofishing operations, determining measures to protect electrofishing team members, and appropriately briefing team members;
2. ensuring precautions are taken in the field to avoid harm to the public, domestic animals, or wildlife;
3. ensuring that all electrofishing operations cease and all crew members go ashore in the event of inclement weather;
4. ensuring that electrofishing operations include only those persons necessary to conduct a safe and efficient operation and those members being trained;
5. reviewing the electrofishing considerations checklist and ensuring the addition of specialized items to the checklist that pertain to their regions or operation; and
6. inspecting electrofishing equipment during the field season to assure that it is properly functioning. If repairs are needed, this must be brought to the attention of the regional BURP coordinator.

- All crew members must know who their leader is and recognize his/her authority as final in operational decisions. Every crew member has the right to ask questions about any aspect of an electrofishing operation. A crew member has the right to decline participation in the operation if he/she feels unsafe working in the field conditions present. Crew members are responsible for reporting all potential work hazards, accidents, incidents, and job related illnesses/injuries to their regional BURP coordinator.

Training and Education

- It is recommended that BURP coordinators attend the US Fish and Wildlife Service Principles and Techniques of Electrofishing course so that they have knowledge of the following:

1. the basic principles of electricity and transmission of current in water;
2. the basic concept and design guidelines for electrofishing equipment;
3. electrofishing equipment, the equipment's capabilities, limitations, and safety features; and
4. the safety precautions to employ while using electrofishing equipment.

- All members of the electrofishing crew must have a current certification in cardiopulmonary resuscitation (CPR) and first aid. All crew members will be briefed in the following areas:

  1. hazards involved in electrofishing;
  2. safe operation of electrofishing equipment;
  3. basic emergency procedures for drowning, unconsciousness, and electrical shock; and
  4. communication between electrofishing crew members while operating equipment.

Standard Safety Equipment

- All persons using portable electrofishers will wear protective gear that will insulate the wearer from electrical shock, preferably chest waders but rubber hip boots could suffice. All footwear will be equipped with non-slip soles.

- Appropriate gloves will be worn and will be inspected for punctures before each use and will be replaced if damaged.

- Polarized sunglasses will be worn when there is glare on the water.

Standard Operating Procedure

- All persons must be aware of the hazards involved in using portable electrofishers in running water, such as slippery surfaces, swift water currents, deep areas, and obstacles such as logs or similar objects.

- A minimum of three people must be present to conduct electrofishing operations.

- At all times during the electrofishing operation, the crew members must be aware as to when the unit is putting power into the water. If a crew member must reach into the water with his/her hands, it is his/her responsibility to inform the person operating the equipment so that he/she can stop the operation. Communication between crew members is essential to a safe operation.

- Netters will work beside or behind the individual with the electrofishing equipment to ensure that the electrical field is well in front of both workers.

- Crew members should only perform one job at a time. A person should not be carrying the bucket of fish and netting at the same time.

- While walking in the stream, make sure that one foot is securely planted before stepping with the other foot. Do not cross one leg over the other, especially while walking in swift water.

- The individual operating the electrofishing unit should not turn the power on until all crew members are in position and have stable footing.

- Crew members will cease electrofishing operations during inclement weather; use discretion during rain.

- All safety equipment will be utilized.

- All operating manuals for electrofishing equipment must be available to the crew while in the field.

Portable Electrofisher Equipment Specifications and Operation

- Only professionally-manufactures electrofishing equipment should be used and the equipment should not be altered in any way.

- Electrodes:
    1. Electrode handles will be constructed of a nonconductive material and be long enough to avoid hand contact with the water.
    2. The positive electrode (anode) used with portable electrofishers will be equipped with a pressure switch that interrupts the electric current upon release.

- Portable Electrical Power Source:
    1. Batteries used as an electrical power source for backpack shockers will be of the gel type that will not leak when tipped or overturned.
    2. Backpacks will be equipped with a quick release belt (hip) and shoulder straps.
    3. Power Control:
        (a) The operator will have a switch to the pulsator or power control unit so that the electricity can be turned off quickly in an emergency.
        (b) All equipment purchased after October 1, 1985, must be equipped with a tilt switch that breaks the circuit if the operator falls.

Definitions

anode: The positive electrode.

cathode: The negative electrode.

deadman switch: A switch which requires constant pressure to supply electrical current to the circuit.

electrofishing: The use of electricity to provide a sufficient electrical stimulus in fish to permit easy capture by netting.

electrofishing team leader: The individual in charge of the electrofishing operation.

ground: A conducting connection, whether intentional or accidental, between an electric circuit or equipment and the earth or to some conducting body that serves in place of the earth.

netter: The individual who nets the captured fish during electrofishing operations.

Appendix IX. Electrofishing Training Acknowledgment Form

Idaho Beneficial Use Reconnaissance Project
ACKNOWLEDGMENT OF ELECTROFISHING ORIENTATION

have received instruction and orientation about electrofishing from the Idaho Division of Environmental Quality. As a result, I understand and accept the following principles:

. Electrofishing (EF) is an inherently hazardous activity in which safety is the primary concern. The electrical energy used in EF is sufficient to cause electrocution. During operations, It is critical to avoid contact with the electrodes and surrounding water. The EF field is most intense near the electrodes, but can extend outward 10-20 feet.

. A communication system must be known by all members of an EF crew. A minimum of three people are required for all EF operations. Crew members should only perform one job at a time (e.g. a person should not be carrying the bucket of fish and netting at the same time).

. The individual operating the electrofishing unit should not turn the power on until all crew members are in position, have stable footing, and all members agree to begin.

. An EF operation should proceed slowly and carefully; avoid fish-chasing and other sudden maneuvers. Operations should cease during inclement weather; use discretion during rain.

. The main power switch must be turned off immediately if an emergency occurs.

. Rubber knee boots are minimal foot protection, as are rubber gloves for the hands. Chest waders with felt soles are recommended. Ear protection is recommended for those working near the generator. Crews will be provided with the necessary safety equipment that is in proper working condition.

. All members of the EF crew must be certified for CPR and first aid. A first aid kit must be within immediate reach during an EF operation.

. Stunned fish should be removed from the EF field as soon as possible, and not subjected to continuous power by being held in the field. Using the anode as a dip net should be avoided is poor electrofishing technique and potentially injourus to fish.

. Measures should be taken to avoid harm to the public, domestic animals, and wildlife. The pulic cannot participate in electrofishing operations.

0. All EF crew members must know who their leader is and recognize his/her authority as final in operational decisions. However, every crew member has the right to ask questions about any aspect of an EF operation. A crew member has the right to decline participation in an EF operation, without fear of employer recrimination, if he/she feels unsafe in doing such work.

Signature of Employee Date

Appendix X. Electrofishing Checklist

Backpack Electrofisher Daily Safety Inspection

ate:______________________ Stream: ______________________________

lectrofishing Leader__________________________ Crew ID:____________

rew Members____

Manual present? Yes ______ No ________

ENERATOR/ALTERNATOR (where applicable)

____ 1. Electrical connections secure and protected
____ 2. Mountings secure
____ 3. Exhaust directed away from operator
____ 4. Oil topped up
____ 5. Gas topped up
____ 6. Engine clean - no oil or gas leaks

BATTERY (where applicable)

____ 1. Fully charged, gel type cell
____ 2. Terminals clean and tight

LECTROFISHER

____ 1. Controls and gauges operational
____ 2. Adequate protection of wiring
____ 3. Adequate connectors and interlocking
____ 4. Audible tone generator working
____ 5. "Kill switch" working
____ 6. Mercury tilt switch working
____ 7. Anode switch working
____ 8. Wiring to anode in good condition
____ 9. Anode in good condition, fastened securely
____ 10. No screens or nets attached to anode
____ 11. Cathode in good condition
____ 12. Cathode clean, fastened securely
____ 13. Backpack frame in good condition
____ 14. Quick release buckle of backpack working

ANCILLARY EQUIPMENT

____ 1. Dip net handle made of non-conductive material
____ 2. First aid kit present
____ 3. Regulation gas containers
____ 4. Fish holding containers
____ 5. Fish measuring board
____ 6. Jars with formalin
____ 7. Fish labels
____ 8. Fish field forms
____ 9. Formalin safety equipment

ERSONNEL/CREW MEMBERS

____ 1. Each crew member briefed on unit operation
____ 2. Three or more crew members present, all CPR certified
____ 3. Each crew member wearing rubber gloves
____ 4. Each crew member wearing waders or rubber boots
____ 5. Safety precautions covered
____ 6. Local arrangements covered (land owner, Fish and Game)

Appendix XI. Vouchering Addendum IDEQ Protocol #6

Fish Vouchering Procedures

Vouchering Purpose

Vouchering of fish specimens is a quality-assurance procedure at DEQ and is a routine step in "good biological science." Vouchered specimens are used for taxonomic quality control, public education, staff training, research and evidence in beneficial use attainability, status, and environmental investigations. To serve these purposes, enough specimens of each species from each site should be vouchered to document the range of size and individual characteristics of each species at a site. This documentation can normally be accomplished by collecting five or six specimens of each species from the site.

Vouchering fish specimens must comply with any applicable scientific collection regulations and restrictions. The Division of Environmental Quality uses the Orma J. Smith Museum of Natural History, Albertson College of Idaho, Caldwell, ID as our depository for fish (and macroinvertebrate) voucher specimens. The Division of Environmental Quality fish collection permits need to specify the Orma J. Smith Museum as the depository for the vouchered material. A photocopy of the collection permit is also needed by the museum to document legal possession of vouchered materials.

Vouchering Procedures

1. Place live specimens in a 10% formalin solution as a fixing agent. Using live specimens allows the formalin solution to be ingested and respirated into the interior organs and tissues of the fish. Specimens over 300 mm (one foot) in length must have a small incision made in the abdomen and/or have formalin injected into the large muscles.

2. Allow the fixed specimens to remain in the formalin solution from 24 - 72 hours depending on their size. Twenty-four hours is normally sufficient for live specimens less than 150 mm.hours. If in doubt, or if the fish were dead prior to placement in the formalin, leave the fish in the formalin longer. Be sure all the specimens are totally covered with formalin.

3. Completely fill out two DEQ fish specimen labels with a No. 2 pencil or alcohol/formalin proof pen such as the Sakura Micron Pigma. Let any ink used dry

completely before placing the label in the sample container. Make an initial field identification of the specimens being vouchered. Place one label in with the vouchered fish. Tape the other to the outside of the sample container.

4. Note on field data sheet which specimens or species were vouchered.

5. Send a legible copy of the field data sheets, a copy of the collection permit and the specimens to Don W. Zaroban (DEQ Central Office, 1410 N. Hilton Street, Boise, ID 83706; phone number: (208) 373-0405).

Appendix XII. Formalin Health and Safety

All field and laboratory activities will be performed in accordance with the Occupational Safety and Health Administrations requirements for a safe work place. It is the responsibility of the participants to establish and implement the appropriate health and safety procedures for the work being performed. All field staff are expected to review and understand the Material Safety Data Sheet and the Chemical Fact Sheet for chemicals of concern provided by field staff supervisors. Field staff are instructed to immediately report to their supervisor the development of any adverse signs or symptoms that they suspect are attributable to chemical exposure.

The environmental samples scheduled to be collected during this project will be obtained from surface water bodies located in natural settings. Samples to be collected include fish specimens and aquatic macroinvertebrates. The sample stations and samples to be collected are not considered to be hazardous; however, sample preservation materials include formalin (formaldehyde) which requires prudent safety precautions by those collecting samples and those coming into contact with, or disposing of, samples collected during this project.

Hazardous Materials (Formaldehyde)

Commercial grade formalin contains 37 to 55 percent formaldehyde. The use of formaldehyde and its derivatives are regulated under 29 CFR 1910.1048. Formaldehyde is a suspected human carcinogen. Formaldehyde is highly flammable and is incompatible with strong oxidizers, strong alkalines, acids, phenols, and urea.

Formaldehyde Exposure Limits

There may be no safe level of exposure to a carcinogen, so all contact with formalin should be reduced to the lowest possible level. The odor threshold of 0.83 parts per million (ppm) for formaldehyde serves only as a warning of exposure. The permissible exposure limit (PEL) for formaldehyde is 0.75 ppm averaged over an eight-hour work shift. The time-weighted average (TWA) for airborne concentrations of formaldehyde (STEL) is 2 ppm. The American Conference of Governmental Industrial Hygienist recommend airborne exposure limit to formaldehyde is not to exceed 0.3 ppm averaged over an eight-hour work period.

Respirators shall be used when 1) installing feasible engineering and work practice controls, 2) engineering and work practice controls are not feasible, and 3) engineering and work practice controls are not sufficient to reduce exposure to or below the

Permissible Exposure Limit. Use only an MSHA/NIOSH-approved and -supplied air respirator with a full face piece operated in the positive mode or with a full face piece, hood, or helmet operated in the continuous flow mode. An MSHA/NIOSH-approved self-contained breathing apparatus with a full face piece operated in pressure-demand or other positive mode is also recommended.

Formaldehyde exposure occurs through inhalation and absorption. Exposure irritates the eyes, nose, and throat and can cause skin and lung allergies. Higher levels can cause throat spasms and a build-up of fluid in the lungs, which are causes for a medical emergency. Contact can cause severe eye and skin burns, leading to permanent damage. These may appear hours after exposure, even if no pain is felt.

Formaldehyde First Aid

If formaldehyde gets into the eyes, remove any contact lenses at once and irrigate immediately with deionized water, distilled water, or saline solution. If formaldehyde contacts exposed skin, flush with water promptly. If a person breathes in large amounts of this chemical, move the exposed person to fresh air at once and perform artificial respiration if needed. When formaldehyde has been swallowed, get medical attention. Give large quantities of water and induce vomiting. Do not make an unconscious person vomit.

Formaldehyde Fire and Explosion Hazard

Mixtures of air and free formaldehyde gas are highly flammable. Formalin is a combustible liquid, and presents a moderate fire and explosion hazard. Use a dry chemical, carbon dioxide, water spray, or alcohol form to extinguish formalin fires. Store formalin solutions in insulated, closed containers in a cool, dry, well-ventilated area separate from oxidizing agents and alkaline materials. Protect formalin containers from physical damage.

Formalin Spill Procedures

In case of a spill or leak, eliminate all sources of ignition, provide adequate ventilation, notify the supervisor, and evacuate all nonessential personnel. Neutralize spilled formalin with aqueous ammonia or mix with sodium sulfite. Wash residues with diluted ammonia to eliminate vapor. Prevent runoff from entering streams, surface waters, waterways, watersheds, and sewers.

Formalin Work Area Controls

Work area locations at stream sampling stations will be selected to ensure adequate ventilation when sample container lids are removed. Work area locations will be located downwind from field crew activities and will be isolated from field crew traffic. A single field crew member will be designated and authorized to secure the formaldehyde work area at sampling stations. This crew member will ensure proper handling of sample containers and fish specimens and will be responsible for establishing proper precautions for minimizing field crew exposure to formaldehyde at sampling stations.

Formalin Work Area Practices

Formalin (formaldehyde) is being used in this protocol for the purpose of asphyxiation and preservation of fish specimens. Pre-labeled and pre-preserved plastic sample containers will be delivered to the field crew secured in large ice chests. Field crews will transport the containers in the coolers to the field sample stations. Fish specimens will be collected by hand and placed into the sample containers. Container lids will be removed immediately prior to and closed immediately after fish specimens and specimen labels are placed into the sample container. Crew members should minimize the amount of time the sample preservative is not contained. The sample container will be placed into a large plastic bag and secured in an ice cooler until it is delivered to the laboratory for analysis.

Formalin Personal Protection

Field crew members within the designated formalin work area at sample stations will wear a full face shield, impervious nitrile, butyl rubber or viton gloves, boots, and aprons, etc. to prevent excessive or prolonged skin contact. Contact lenses will not be worn within the designated formalin work area. No eating, drinking, or smoking will be allowed in the designated formalin work area.

Wash thoroughly after using formalin. Avoid transferring formalin from hands to mouth while eating, drinking, or smoking. Avoid direct contact with formalin. Remove contaminated clothing and launder before wearing. Contaminated work clothing should not be taken home. Contaminated work clothing should be laundered by individuals who have been informed of the hazards of exposure to formalin.